KENWOOD

SERVICE MANUAL

TR-7600

2m FM TRANSCEIVER

INDUCTION/CONTENTS

INTRODUCTION

Your KENWOOD Model TR-7600 is an advanced 2-meter transceiver for amateur mobile, and optional fixed station operation.

The TR-7600 features:

- ☆ Memory channel (simplex and repeater mode).
- ☆ Memory TX and ±600 kHz repeater TX for repeater operation.
- ☆ 800 channel PLL circuit.
- ☆ Digital frequency display.
- ☆ Dual concentic frequency selector switches.
- ☆ PLL UNLOCK and ON AIR indicators.
- ☆ Subaudible ON/OFF switch (Encoder user installed).
- ☆ Powered tone pad connector with 9V DC on one pin.
- ☆ Pin Mic connector with 9V DC on one pin.
- ☆ TX HI-LOW (Power) switch.

CONTENTS

GENERAL/CIRCUIT DESCRIPTION

GENERAL

The TR-7600 is a 10W, multi-channel (800 channels) FM transceiver covering 144 ~ 147.995 MHz. It features a built-in repeater shift circuit and memory circuit, and provision for connection of an option remote controller for operation with a micro-computer.

PLL CIRCUIT

The TR-7600 employs PLL circuit composed of IC SM5111A for programmable counter, reference oscillator, frequency divider and phase detector. Setting of frequency division ratio, frequency memory and remote indication functions are all controlled by BCD codes.

PLL CIRCUIT BLOCK DIAGRAM

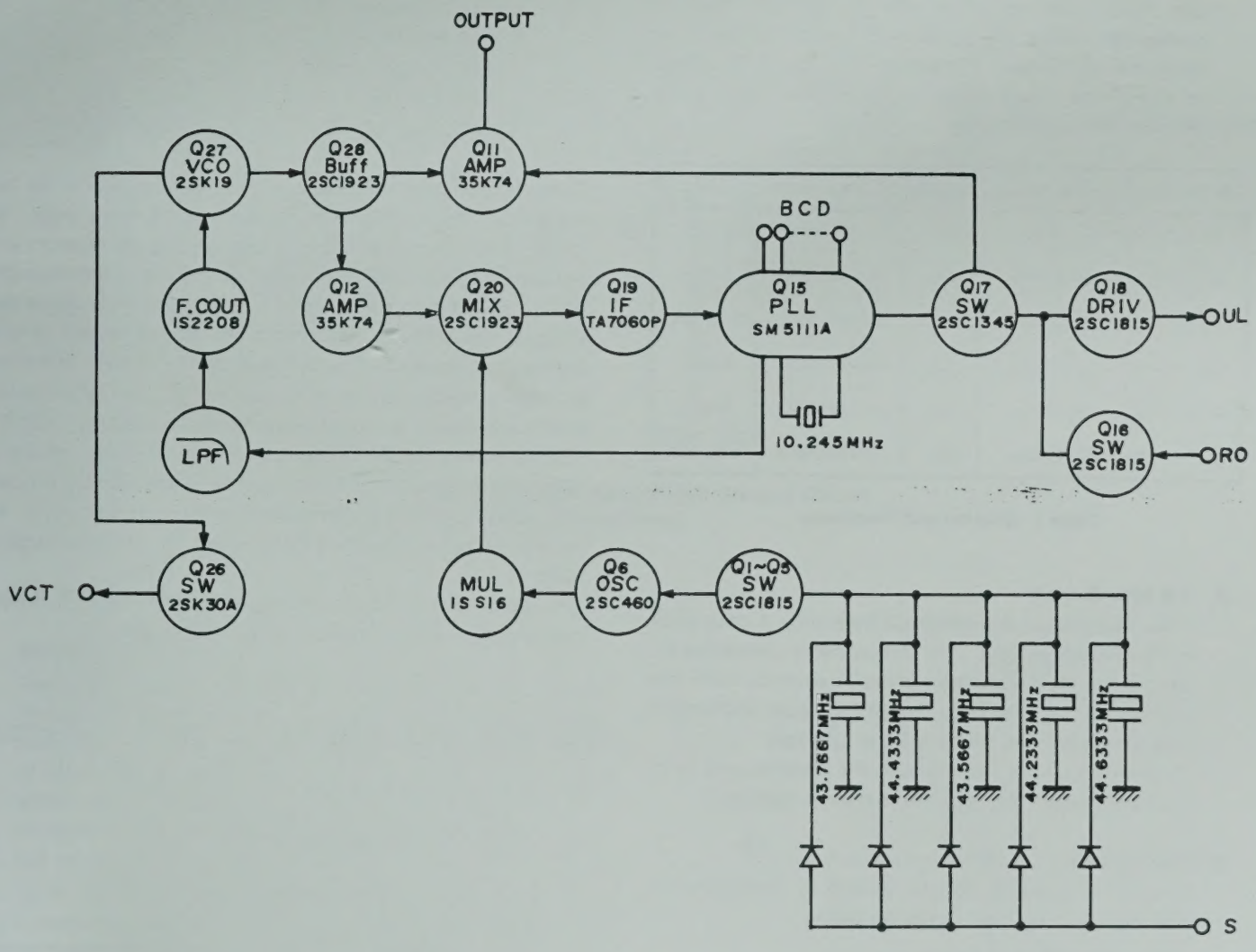


Fig. 1 PLL Circuit

CIRCUIT DESCRIPTION

1. Phase Locked Loop

The 130 MHz signal from Q27 passes through the buffer circuit Q28 and is then divided into a synthesizer output and a loop output by Q11 and Q12 respectively. The output from Q12 is mixed with the local oscillator output, trippled by Q6 and 1SS16, by Q20 to obtain IF frequency. The IF output is amplified by Q19 and is fed to Q15 where the output is frequency divided in the ratio specified by BCD code to compare it with the 10 kHz reference frequency (1/1024 of 10.240 MHz).

The DC output thus obtained passes through the low-pass filter to control the VCO vari-cap 1S2208. The output from Q26 controls the transmit frequency bandwidth. When the signal is unlocked, the output is shut off by Q17 which is indicated by Q18. Q16 is used to shut off the output when the rotary switch is between channel setting positions.

Rx Tx Freq.	Simplex Output	Division	Osc Xtal Freq.	IF Freq.
144.00 MHz	133.3 MHz	200	43.7667 MHz	2 MHz
145.00 MHz	134.3 MHz	300	43.7667 MHz	3 MHz
145.99 MHz	135.29 MHz	399	43.7667 MHz	3.99 MHz
146.00 MHz	135.3 MHz	200	44.4333 MHz	2 MHz
147.00 MHz	136.3 MHz	300	44.4333 MHz	3 MHz
147.99 MHz	137.29 MHz	399	44.4333 MHz	3.99 MHz

Table 1 Division and Frequency

2. +5 kHz Circuit

In the PLL circuit, the reference frequency is controlled in 10 kHz steps. The +5 kHz signal is controlled by varying the local oscillator crystal frequency with the vari-cap, so the frequency division remains unchanged even when the +5 kHz circuit is operated.

The memory circuit also includes the same bit and functions even when the +5 kHz circuit is operating.

3. Shift Circuit

Transmit frequencies can be shifted by changing the local oscillator crystal, as shown below.

144 and 145 MHz bands:

[−] shift	43.5667 MHz
[S]	43.7667 MHz

The [+] shift is not available for 144 and 145 MHz bands.

The [S] is obtained at the [+] position.

146 and 147 MHz Bands:

[−] shift	44.2333 MHz
[+] shift	44.6333 MHz
[S]	44.4333 MHz

4. Memory Shift Circuit

The memory shift circuit (MT) is a circuit to shift the memory input frequency during transmission. The function is the same as in [S].

CONTROL UNIT

Frequency settings are accomplished by the MHz, 100 kHz and 10 kHz rotary switches. The relationship between the frequency and frequency division is shown below.

Frequency	Frequency division
144.000 MHz	200
145.000 MHz	300
145.990 MHz	399
146.000 MHz	200
147.000 MHz	300
147.990 MHz	399

The local oscillator frequency of kHz order can be shifted by the switch. The frequency division set by the rotary switch is stored in the latch IC's 1, 2 and 3 by pressing the memory input switch. The output from the latch circuit is fed through IC's 4, 5 and 6 in the selector circuit to the PLL circuit by pressing the memory call switch. When this switch is not pressed, the output is directly fed to the PLL circuit. Memory function is effected by latching each switch. The information from each switch is stored by pressing the memory switch. The stored information remains the same unless the memory switch is pressed once again. Selection of memory output and rotary output is accomplished by the selector circuit. A latched output is obtained by pressing the memory output switch.

The signal to the PLL circuit passes through the LED driver circuit and is digitally indicated by LED (orange).

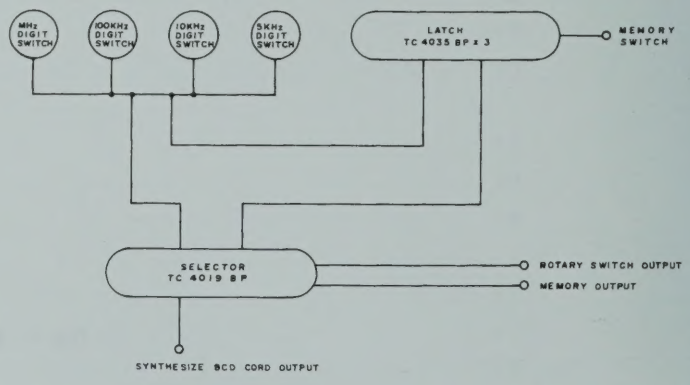


Fig. 2 Block Diagram of Frequency Memory Circuit

CIRCUIT DESCRIPTION

TRANSMITTER UNIT

The microphone signal passes through the limiter amplifier and is FM modulated by the 10.7 MHz oscillator. The signal is mixed with the local oscillator signal to obtain 144 ~ 146 MHz signal. The B.P.F. is of a variable type, providing excellent characteristics with respect to power and spurious even at the shift time because of the use of VCO voltage. The power stage uses the power module M5711 manufactured by the Mitsubishi Electric Co., to provide higher reliability.

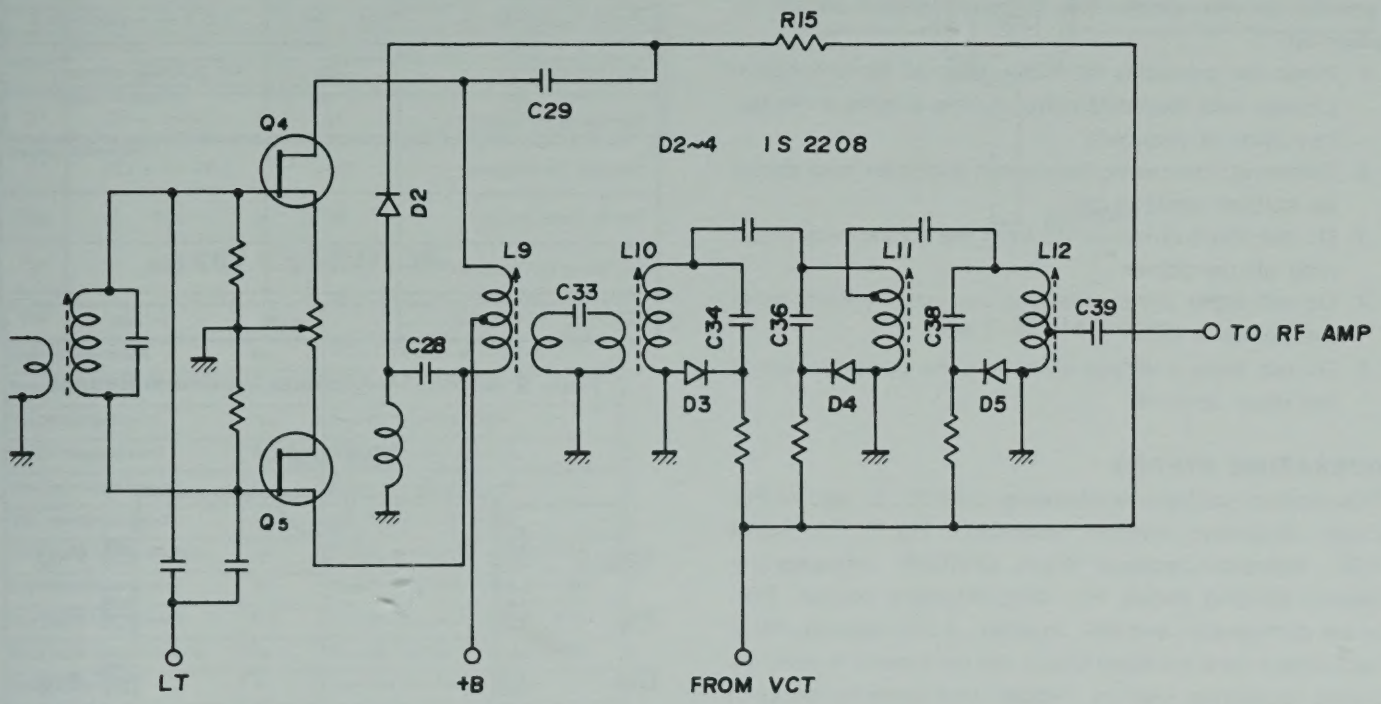


Fig. 3 Variable Band Width Control Circuit (for Transmission)

RECEIVER UNIT

The signal from the transmit/receive matching circuit passes through the diode switch and is fed to the 2-stage antenna tuning circuit, 3-stage merical tuning circuit and RF amplifier of MOS FET. This signal is further fed to the mixer circuit MOS FET where it is converted into 10.7 MHz signal. The signal thus converted passes through the 2-stage filter and is fed to the 2nd mixer where it is converted into 455 kHz signal. The 2nd IF signal from the 455 kHz ceramic filter passes through the limiter circuit where it is converted into AF signal by the ceramic discriminator. This signal is amplified by the audio power amplifier to drive the speaker.
The receiver unit includes a noise amplification type squelch circuit. This circuit picks up the noise component in the squelch signal from the discriminator which is amplified and rectified to control the 1st stage AF amplifier.
The characteristic of the discriminator is opposite that of conventional ones to permit connection of a remote controller.

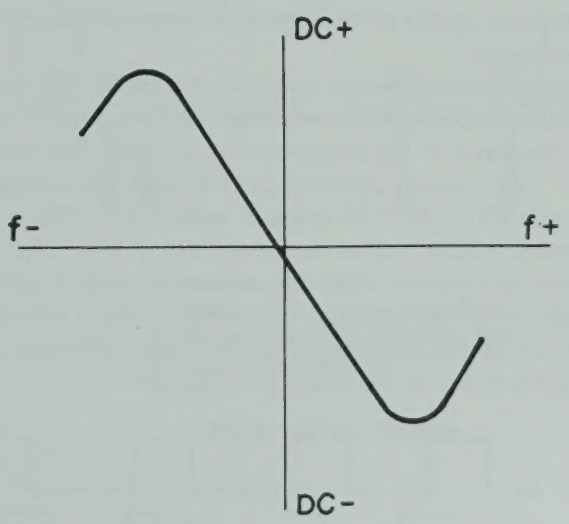


Fig. 4 Discriminator Characteristics

SM5111A

Electrostatic Breakdown Protection

This product has a built-in input protection circuit to prevent a gate breakdown due to static electricity.

In order to protect the input circuit from damage due to a large static electricity or voltage in excess of the limit permissible to the circuit, the following points should be observed:

1. When the product is not in use, keep all the terminals in contact with insulating material (this is done at the factory prior to shipment).
2. Soldering iron, testing instrument and other tools should be earthed while in use.
3. Do not insert or remove IC from the socket without turning off the power.
4. Do not apply signal voltage to the input terminal when the power is OFF.
5. Do not apply a voltage exceeding the power voltage to the input terminal.

OPERATING SYSTEM

This product has been developed as C-MOS LSI used for PLL circuit. As shown in the block diagram in Fig. 1, it consists of OSC: reference oscillator circuit, DIVIDER: reference frequency dividing circuit, PC: programmable counter, PD: phase comparator, and INV: inverter. A high accuracy feedback type crystal oscillator circuit can be formed by adding a crystal oscillating element, resistor and capacitor between the QIN and QOUT terminals of the reference oscillator circuit. This also permits an external signal to be fed to the QIN terminal.

The oscillator output is applied to the reference frequency dividing circuit where it is divided into the desired frequencies of fr1 (1/2028) and fr2 (1/1024) which are the reference signals of the digital type phase comparator on the next stage.

The comparison signal (frequency f1) fed to the input terminal FIN of the AMP is amplified and wave shaped, then fed to the input of the programmable counter. The frequency "f1" is frequency converted (fpc) through the program terminals P01 ... P33 (for example, when P01 ... P33 = 1, the programmable counter output is 1/999), and is fed to the phase comparator where the reference signal is compared with the comparison signal in phase so that a pulse signal, shown below, proportional to the phase difference in two signals is fed to the output terminal DO.

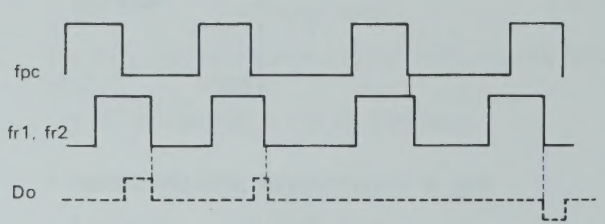


Fig. 5

The table below shows the maximum limits of operating conditions and environmental conditions. If any of these values exceeds the given limits, it can be a cause of damage to the product or deterioration of quality.

Item	Symbol	Rating	Unit
Power Supply Voltage	DDV -Vss	−0.3 ~ +7.5	V
Input Voltage	VIN	Vss ≦ VIN ≦ VDD	V
Operating Temperature	TA	−30 ~ +70	°C
Storage Temperature	TSTG	−40 ~ +125	°C
Power Consumption	PD	250	mW
Soldering Temperature		260	°C
Soldering Time		5	sec

Table 2 SM5111A Absolute Maximum Ratings

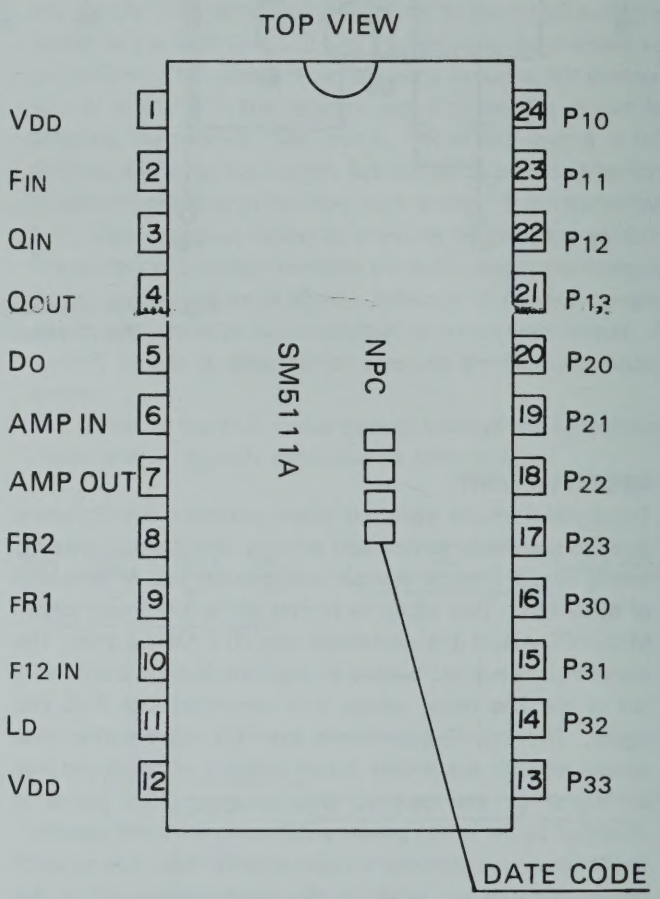


Fig. 6 SM5111A Pin Arrangement

DATA

3SK74

SPECIFICATIONS

Application	VHF RF Amplifier (Mixer)	
Construction	N-Channel • MOS FET (Dual Gate)	
Drain • Source Voltage	V_{DSX}	20V
Gate 1 • Source Voltage	V_{G1S}	±10V
Gate 2 • Source Voltage	V_{G2S}	±10V
Drain Current	I_D	25 mA
Allowable Loss	P_T	200 mW
Channel Temperature	T_{CH}	125°C
Storage Temperature	T_{STG}	−5.5 ~ +125°C

Maximum Specifications

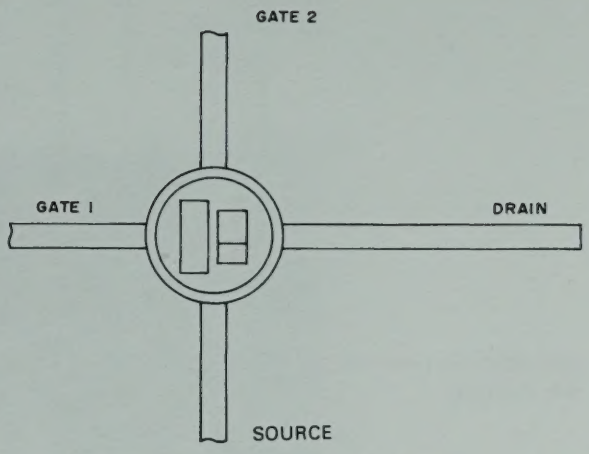


Fig. 7 3SK74 Outlines

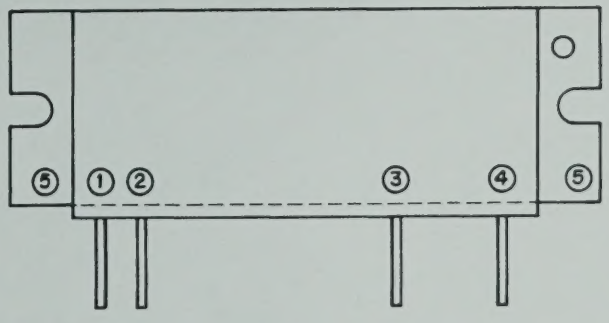
TEST CONDITION

Item	Code	Condition
Drain • Source Voltage	V_{DSX}	V_{G1S} = −3V, V_{G2S} = 3V, I_D = 500nA
Drain Current	I_{DSS}	V_{DS} = 6V, V_{G1S} = 0, V_{G2S} = 3V
Cut-Off Voltage (Gate 1)	V_{G1S}	V_{DS} = 6V, V_{G2S} = 0, I_D = 500nA
Cut-Off Voltage (Gate 2)	V_{G2S}	V_{DS} = 6V, V_{G1S} = 0, I_D = 500nA
Gate Leak Current (Gate 1)	I_{G1SS}	V_{DS} = 0, V_{G1S} = ±10V, V_{G2S} = 0
Gate Leak Current (Gate 2)	I_{G2SS}	V_{DS} = 0, V_{G1S} = 0, V_{G2S} = ±10V
Small Signal Transfer Admittance	$\|y_{fs}\|$	V_{DS} = 6V, V_{G2S} = 3V, I_D = 10mA, f = 1.0 kHz
Small Signal Input Capacity	C_{iss}	V_{DS} = 6V, V_{G2S} = 3V, I_D = 10mA, f = 1.0 MHz
Small Signal Output Capacity	C_{oss}	V_{DS} = 6V, V_{G2S} = 3V, I_D = 10mA, f = 1.0 MHz
Small Signal Feedback Capacity	C_{rss}	V_{DS} = 6V, V_{G2S} = 3V, I_D = 10mA, f = 1.0 MHz
Output Power Gain	G_P	V_{DD} = 10V, I_D = 10mA, f = 200 MHz
Noise Figure	NF	V_{DD} = 10V, I_D = 10mA, f = 200 MHz

Maximum Rating of M57711

(TA = 25°C, unless otherwise noted)

Item	Symbol	Condition	Value	Unit
Operating Voltage	V_{CC}		17	V
DC Current	I_{CC}		5	A
Operating Temperature	$T_{C(OP)}$		−30 ~ +110	°C
Storage	T_{STG}		−30 ~ +110	°C



1. Input Terminal (RFI)
2. Power Supply of Drive Stage (DRB)
3. Power Supply of Output Stage (FIB)
4. Output Terminal (RFO)
5. GND

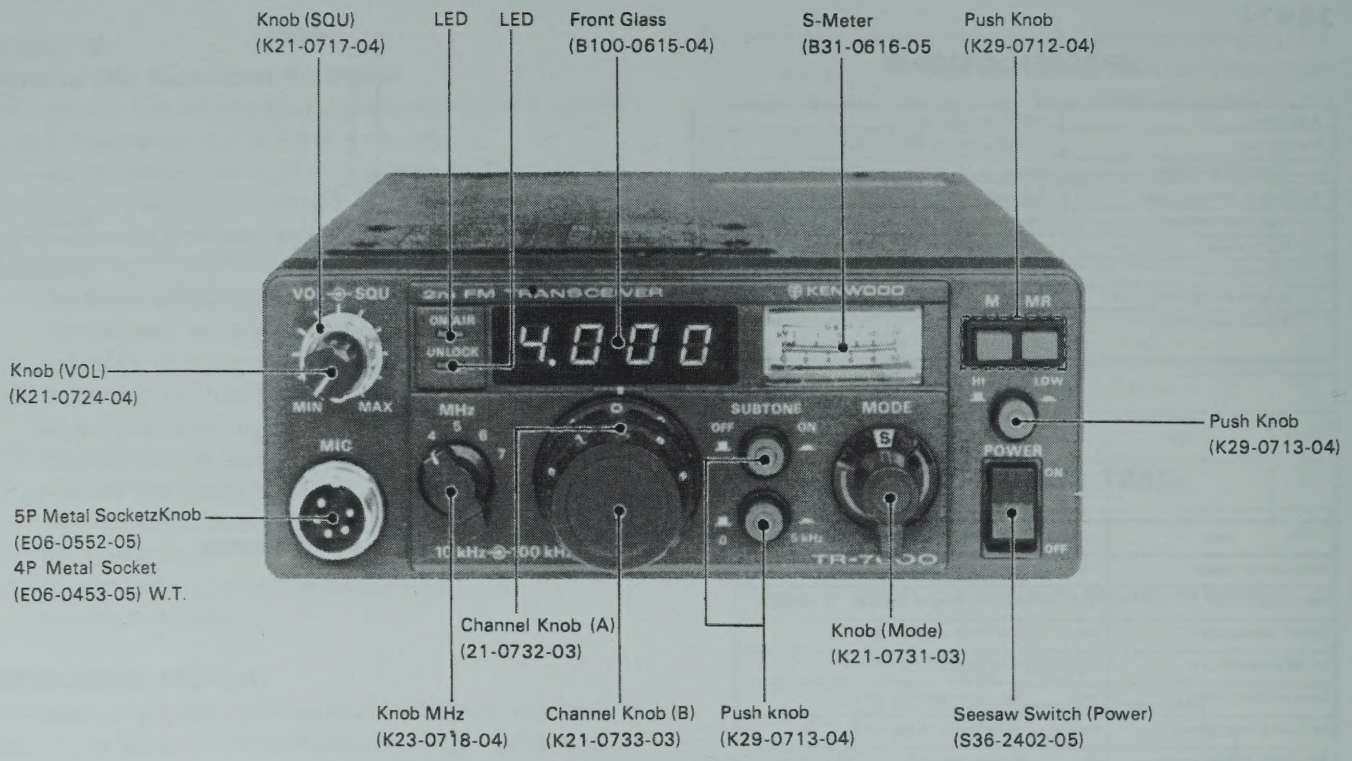
Fig. 8 M57711 Outlines

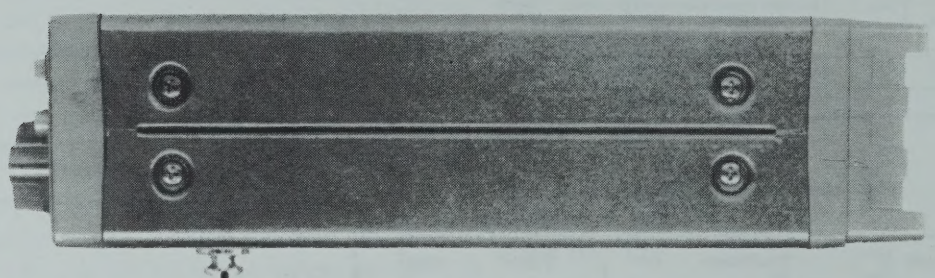
Electrical Characteristic of M57711

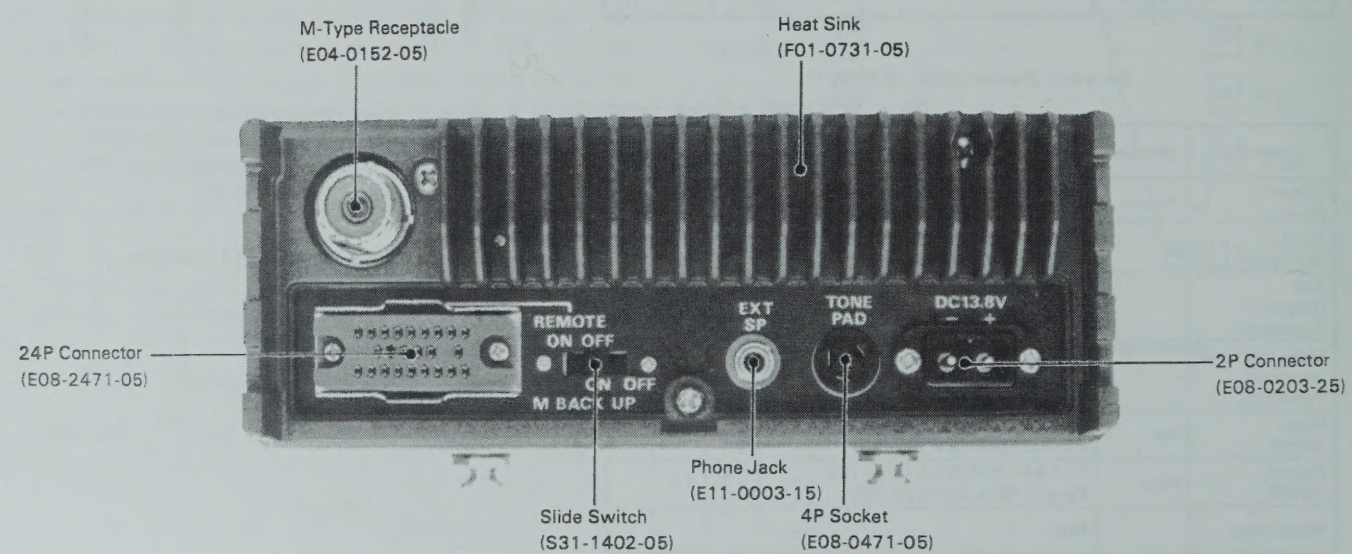
(TA = 25°C unless otherwise noted)

Item	Symbol	Condition	Value			Unit
			Min.	Std.	Max.	
Output Power	P_O	f = 144 ~ 148 MHz, V_{CC} = 12V, Pin = 0.15W, Z_G = Z_L = 50Ω	14	16		W
Total Efficiency	S_T	f = 144 ~ 148 MHz, V_{CC} = 12V, Pin = 0.15W, Z_G = Z_L = 50Ω	53	58		%
2nd Harmonic Radiation		f = 144 ~ 148 MHz, V_{CC} = 12V, Pin = 0.15W, Z_G = Z_L = 50Ω			−25	dB
More than 3rd Harmonic Radiation		f = 144 ~ 148 MHz, V_{CC} = 12V, Pin = 0.15W, Z_G = Z_L = 50Ω			−35	dB
Input VSWR	P_{IN}	f = 144 ~ 148 MHz, V_{CC} = 12V, Pin = 0.15W, Z_G = Z_L = 50Ω		2.5	2.8	
Output VSWR	P_{OUT}	f = 144 ~ 148 MHz, V_{CC} = 12V, Pin = 0.15W, Z_G = Z_L = 50Ω		1.3	1.5	
Impedance		Note	∞ : 1			

PANEL CONTROLS

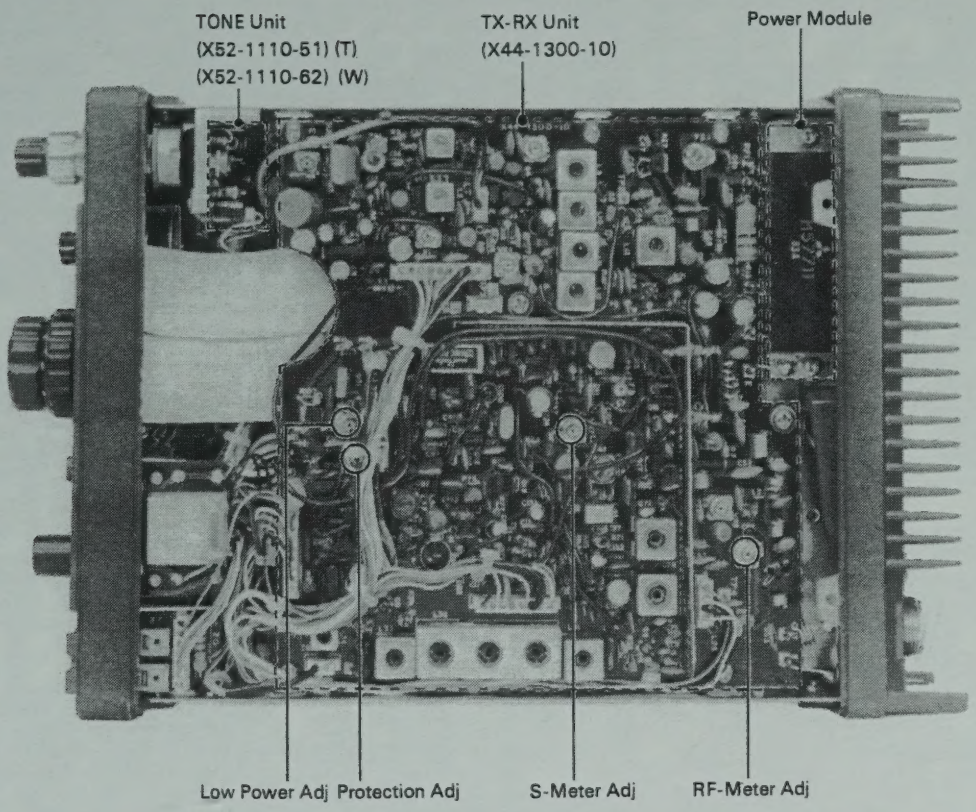




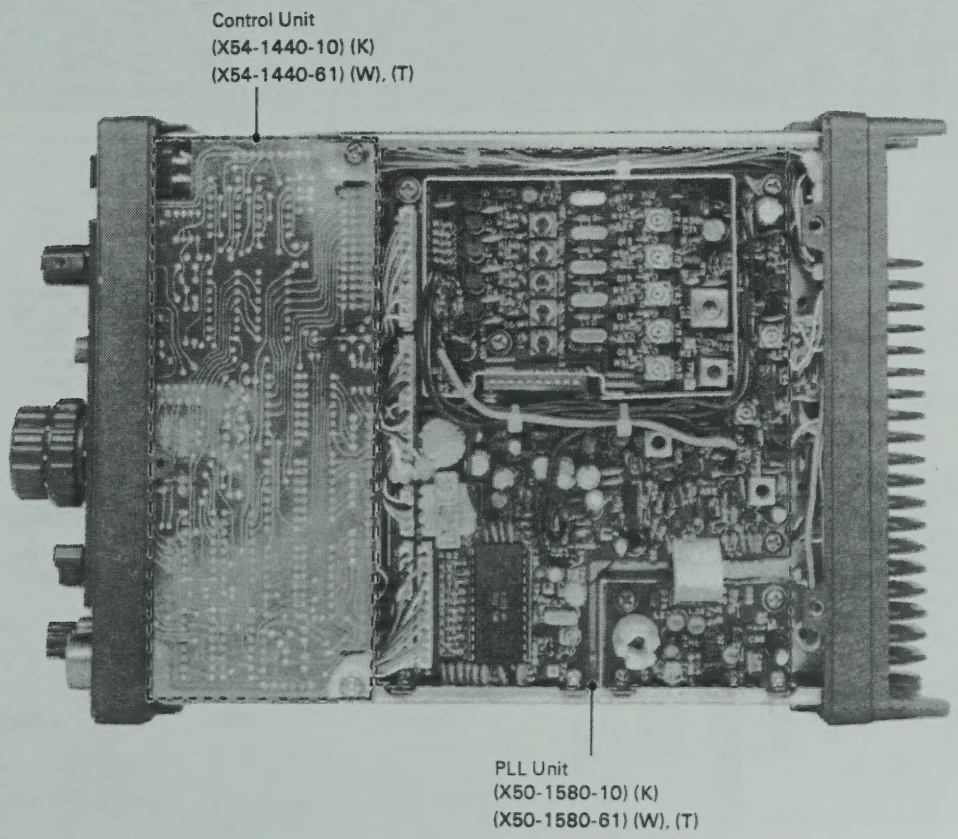


PARTS ALIGNMENT

VIEWED FROM TOP

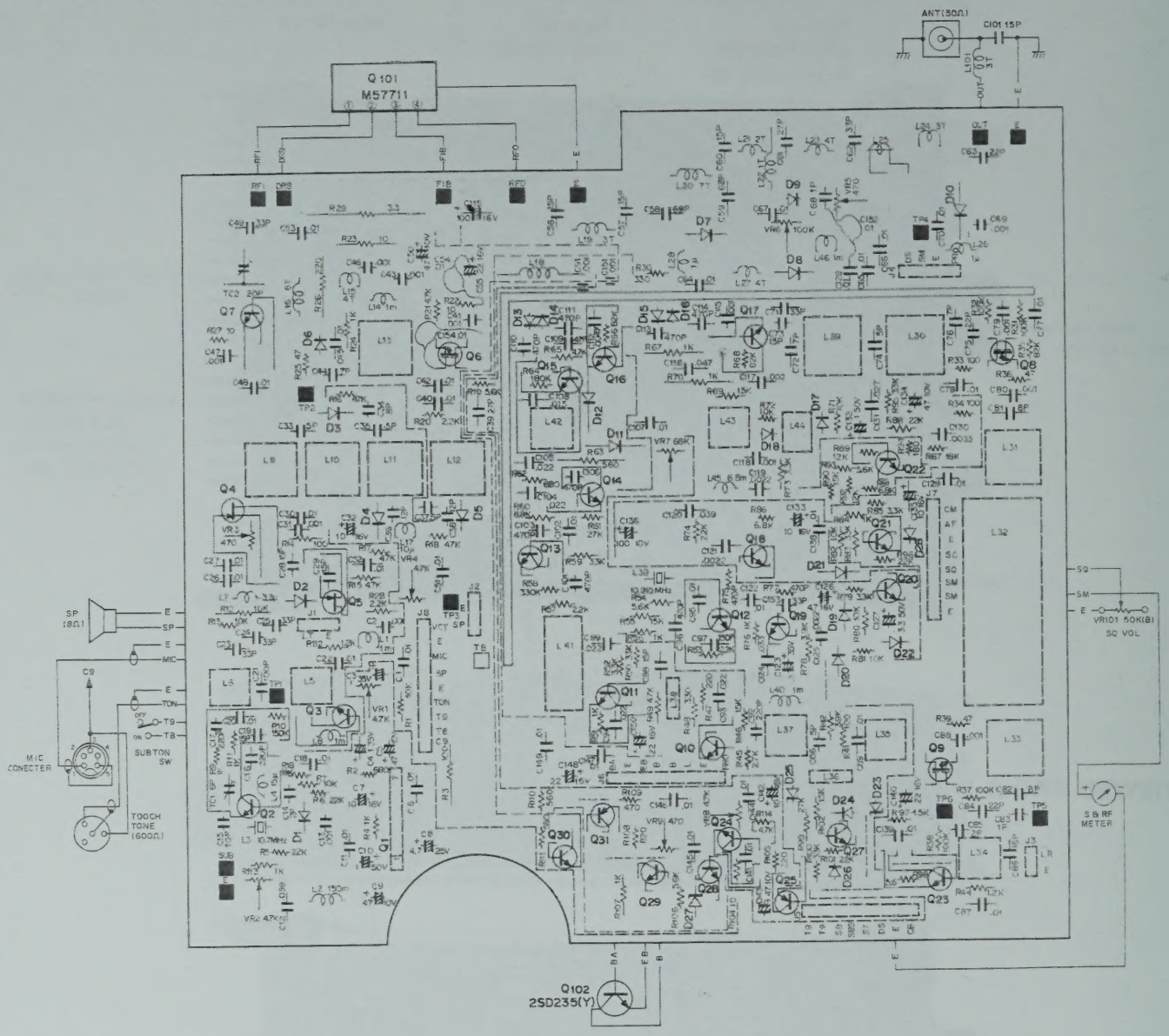


VIEWED FROM BOTTOM



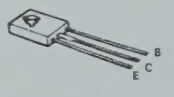
PC BOARD

■ TX-RX UNIT (X44-1300-10)



Q1	:TA7061AP	Q18~22,28,29,30		D1~5,	:IS2208	D23	:XZ-088
Q2,3,10~17	:2SC460(B)		:2SC1815(Y)	D6,13~16,21,24,26,28	:IS1555	D25	:WZ-100
		Q23,24	:2SC496(Y)	D7	:MI402	D27	:WZ-061
Q4,5	:2SK19(GR)	Q25	:2SA1015(Y)	D8	:IS2588		
Q6,8,9	:3SK74(L)	Q27	:2SC1959(Y)	D9~12,17,18,19,20	:IN60		
Q7	:2SC2053	Q31	:2SA496(Y)	D22	:IS1212		

2SA496(Y)
2SC496(Y)

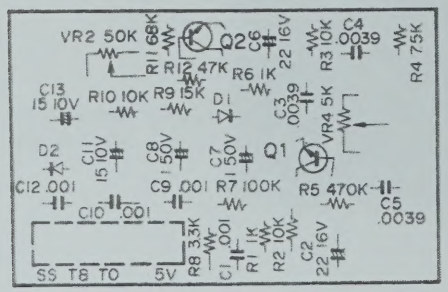


2SK19(GR)

2SC458(B)
2SC460(B)

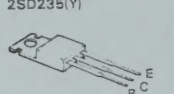
2SA1015(Y)
2SC1815(Y)
2SC1959(Y)

TONE UNIT (X52-1110-51) T TYPE

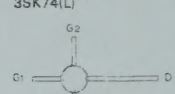


Q1,2 : 2SC458 (B)

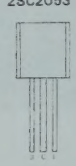
2SD235(Y)



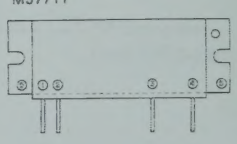
3SK74(L)



2SC2053

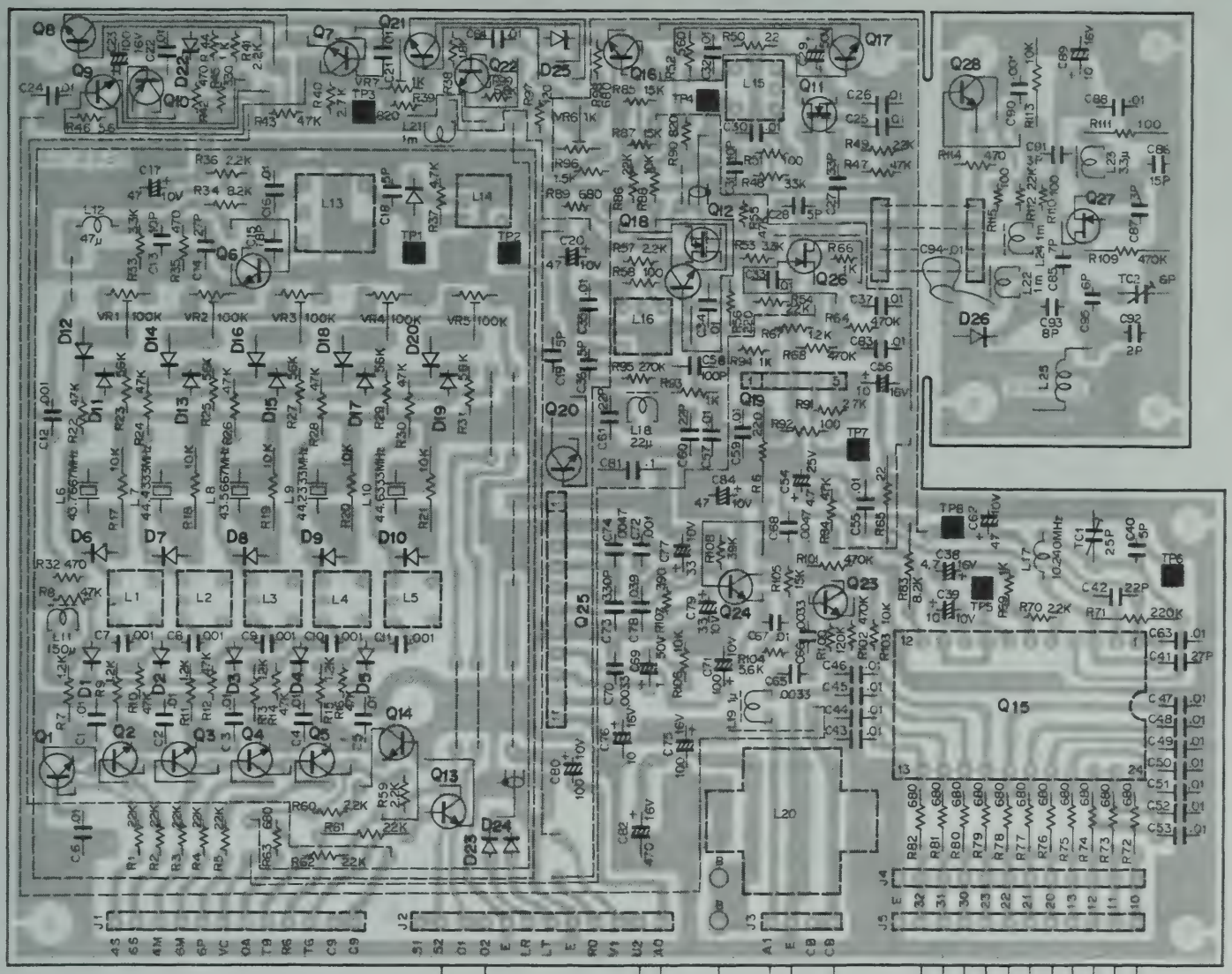


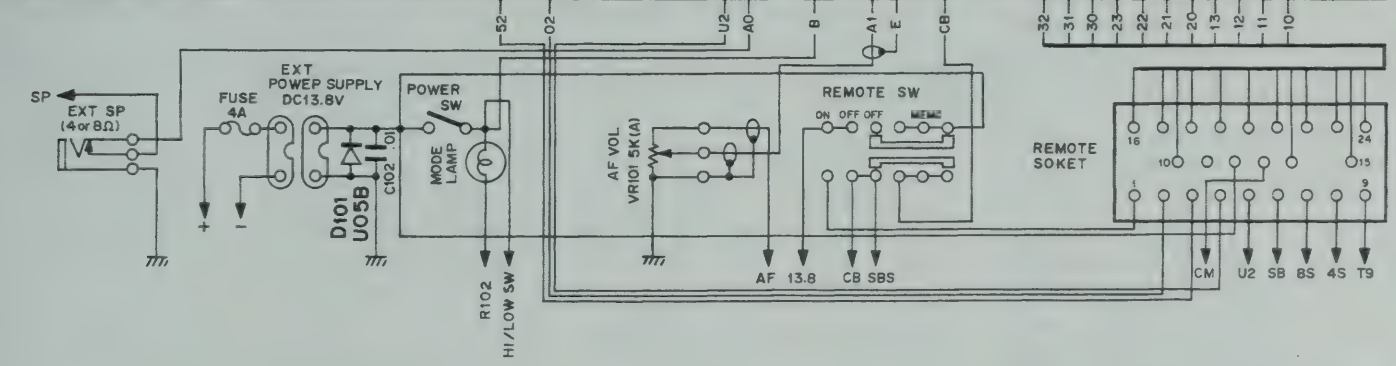
M57711



PC BOARD

■ PLL UNIT (X50-1580-10)



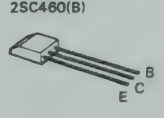


2SK30A(GR)

2SA496(Y)

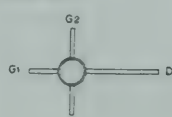
2SK19(GR)

2SC460(B)

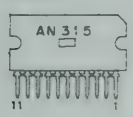


2SA1015(Y)
2SC1345(E)
2SC1815(Y)
2SC1923(O)
2SC1959(Y)
2SC2240(GR)

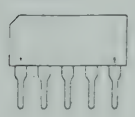
3SK74(L)



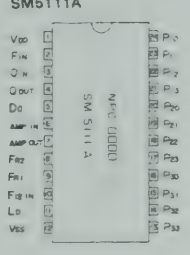
AN315



TA7060P



SM5111A

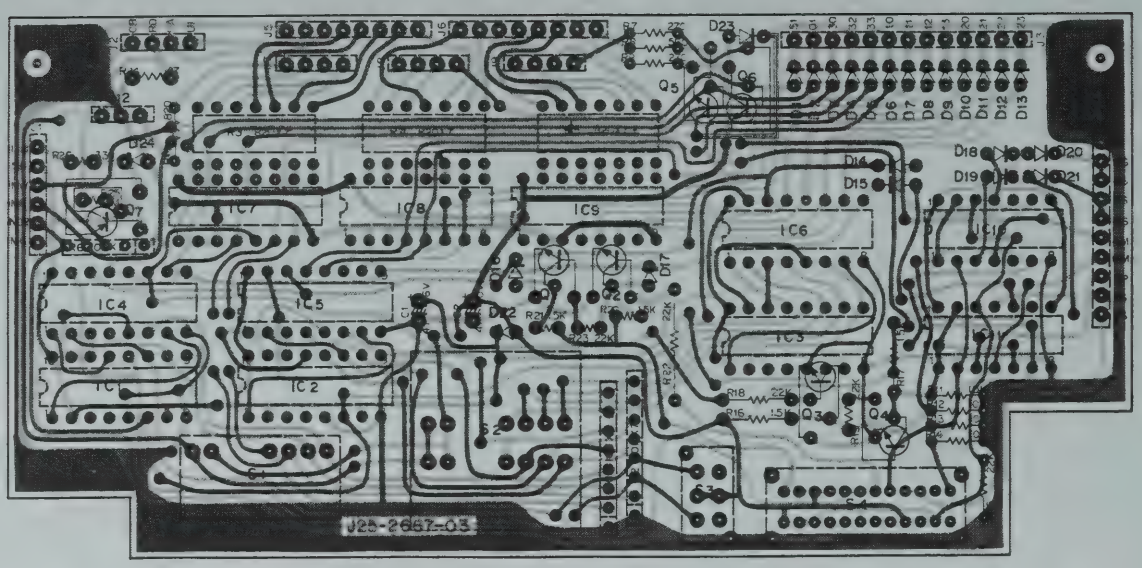


Q1~3,4,5,7,8,13,14,16,18,21,22	: 2SC1815(Y)
Q6	: 2SC460(B)
Q9	: 2SC1959(Y)
Q10	: 2SA496(Y)
Q11,12	: 3SK74(L)
Q15	: SM5111A
Q17	: 2SC1345(E)
Q19	: TA7060P
Q20,26	: 2SC1923(O)
Q23,24	: 2SC2240(GR)
Q25	: AN315
Q26	: 2SK30A(GR)
Q27	: 2SK19(GR)
D1~5	: 1S2588
D6~10	: 1SV53A
D11~20	: 1S1555
D21	: 1S816
D22	: XZ-060
D23~24	: 1S2588
D25	: WZ-040
D26	: 1S2208

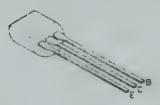
PC BOARD

■ CONTROL UNIT (X54-1380-00)

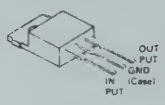
J25-2668-04



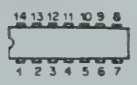
2SA1015(Y)
2SC1815(Y)



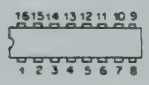
FS-7806M



TC4081P

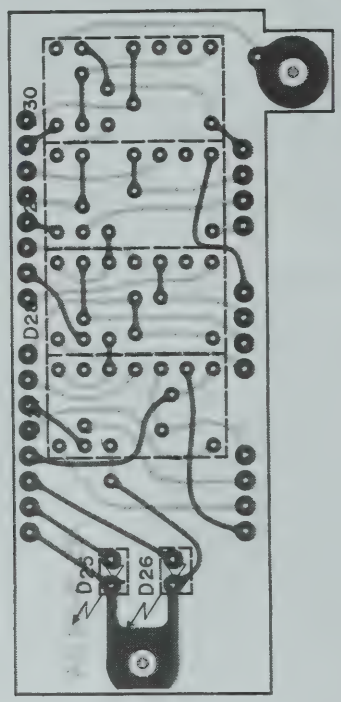


TC5022BP
TC4019BP
TC4035BP

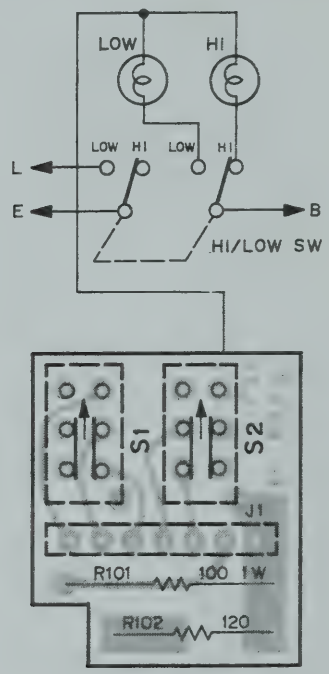


IC1~3	:TC4035BP	Q1~7	:2SC1815(Y)
IC4~6	:TC4019BP	Q7	:2SA1015(Y)
IC7~9	:TC5022BP	D1~13,15~22	:1N60
IC10,11	:TC4081P×3/4	D23	:1S1555
IC10,11	:TC4081P×1/4	D24	:WZ-150
IC12	:FS-7806M	D25	:TLG-205
		D26	:TLR-205
		D27~30	:5130K

J25-2668-04 (Indicator)



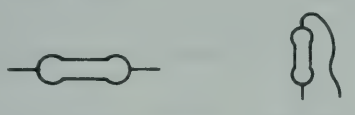
J25-2664-04 (Switch)



PARTS LIST

NOTE:
Except special types (example: cement, metal film, etc.) resistors are not detailed in the PARTS LIST. Regarding value, refer to the schematic diagram or the PC board illustration. Resistors not otherwise detailed are carbon type (1/4 or 1/8W).
Order carbon resistors according to the following example:
A carbon resistor's part number is RD14BY 2E222J.

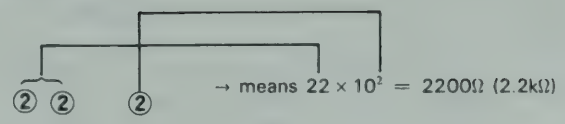
1. Type of the carbon resistor



RD14BY RD14CY

2. Wattage
   1/4W → 2E
   1/8W → 2B

3. Resistance value



Significant figure Multiplier
Example:
221 → 220Ω
222 → 2.2kΩ
223 → 22kΩ
224 → 220kΩ
225 → 2.2MΩ

GENERAL

☆ : New parts

Ref. No.	Parts No.	Description	Remarks
		CAPACITORS	
C101	CC45SL2H150D	Ceramic 15pF ±0.5pF	
C102	CK45F1J103Z	Ceramic 0.01μF +80,−20%	
C103	CK45B1H221K	Ceramic 220pF ±10%	
C104	CC45SL1H181J	Ceramic 180pF ±5%	
		SEMICONDUCTOR	
Q101	V30-1030-36	Power module M57711	☆
Q102	V04-0046-05	Transistor 2SD235 (Y)	
D101	V11-0270-05	Diode V05B	
		COIL	
L101	L34-0821-05	(No care) 5φ3T	☆
		POTENTIOMETER	
VR101	R19-9403-05	15kΩ (A) 50k (B)	
		MISCELLANEOUS	
—	A01-0734-13	Case (A)	☆
—	A01-0735-03	Case (B)	☆
—	A20-2334-05	Die casting panel (Front) (K)	☆
—	A20-2339-03	Die casting panel (Front) (W)	☆
—	A20-2340-03	Die casting panel (Front) (T)	☆
—	B05-0707-04	Speaker grill cloth	☆
—	B10-0615-04	Front glass	☆
—	B31-0616-05	Meter	☆
—	B30-0802-05	Plot lamp (white)	
—	B30-0803-05	Pilot lamp (Blue)	
—	B30-0106-05	Pilot lamp (Small)	
—	B42-1602-04	Sticker (K)	
—	B46-0058-00	Warranty card (K)	
—	B50-2614-00	Operating manual (K)	☆
—	B50-2628-00	Operating manual (W)	☆
—	B50-2629-00	Operating manual (T)	☆
—	E04-0152-05	M type receptacle	
—	E06-0453-05	4P metal socket (MIC) (W) (T)	☆
—	E06-0552-05	5P metal socket (MIC) (K)	☆
—	E07-0451-05	4P metal consent (W) (T)	☆
—	E07-0551-05	5P metal consent (K)	☆
—	E08-0203-25	2P connector (Jack)	

Ref. No.	Parts No.	Description	Remarks
—	E08-0471-05	4P socket (TONE PAD) (K)	
—	E09-0471-05	4P plug (TONE PAD) (K)	
—	E09-0203-25	2P connector (Plug)	
—	E11-0003-15	Earphone jack	
—	E12-0061-05	Phone plug	
—	E23-0043-04	Antenna earth lag	
—	E23-0015-04	Earth lag	
—	F01-0731-05	Heat sink	☆
—	F05-4022-05	Fuse (4A) × 2	
—	F20-0078-05	Isulating plate	
—	F29-0014-05	Insulating washer	
—	G02-0505-05	Fitting spring for knob	
—	G11-0054-14	Insulating cushion × 2	
—	G13-0616-04	Cushion (A) × 2	☆
—	G13-0617-04	Cushion (B)	☆
—	H01-2590-03	Carton case (Inside) (K) (W)	☆
—	H01-2607-03	Carton case (Inside) (T)	☆
—	H10-2519-02	Cushion	☆
—	H10-2501-03	Styren foam cushion	
—	H12-0447-04	Cushion	☆
—	H20-1408-03	Protection cover	☆
—	H25-0049-03	Bag with accessory	
—	H25-0079-04	Polytylene bag (MIC)	
—	H25-0103-04	Polyetylene bag (Cord)	
—	J13-0029-05	Fuse holder	
—	J21-2608-03	C type angle	☆
—	J51-0006-15	Snap-lock × 2	
—	J61-0019-05	Vinyl tie	
—	K21-0724-04	Knob (Outside)	☆
—	K21-0731-03	Knob (Mode) (K)	☆
—	K21-0732-03	Knob channel (A)	☆
—	K21-0733-03	Knob channel (B)	☆
—	K21-0741-03	Knob mode (W) (T)	☆
—	K23-0717-04	Knob	☆
—	K23-0719-04	Knob MHz	☆
—	K29-0712-04	Knob push (square) × 2	☆
—	K29-0713-04	Knob push (circle) × 3	☆
—	N99-0304-04	Hex. socket screws × 4	☆
—	S31-1402-05	Slide switch (remote)	
—	S36-2402-05	See saw switch (power)	

PARTS LIST

Ref. No.	Parts No.	Description	Remarks
—	S40-2409-05	Push switch (M)	☆
—	S40-2404-05	Push switch (MR)	
—	S40-2403-05	Push switch SUB, HI/LOW (W) HI/LOW	
—	T07-0201-05	Speaker (8Ω)	
—	T91-0310-05	Microphone (K)	☆
—	T91-0302-05	Microphone (W)	
—	T91-0301-05	Microphone (T)	
—	W01-0401-04	Wrench (Hex)	☆
—	X44-1300-10	TX-RX unit	
—	X50-1580-10	PLL unit (K)	☆
—	X50-1580-61	PLL unit (W) (T)	☆
—	X52-1110-62	TONE unit (W)	☆
—	X52-1110-51	TONE unit (T)	☆
—	X54-1440-10	CONTROL unit (K)	☆
—	X54-1440-61	CONTROL unit (W) (T)	☆

TX-RX Unit (X44-1300-10)

Ref. No.	Parts No.	Description	Remarks
		CAPACITOR	
C1	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C2	CK45B1H102K	Ceramic 0.001μF ±10%	
C3,4	CS15E1V0R1M	Tantalum 0.1μF 16WV	
C5	CE04W1A470	Electrolytic 47μF 10WV	
C6	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C7	CE04W1C100	Electrolytic 10μF 16WV	
C8	CE04W1E4R7	Electrolytic 4.7μF 25WV	
C9	CE04W1A470	Electrolytic 47μF 10WV	
C10	CE04W1H010	Electrolytic 1μF 50WV	
C11	CQ92M1H103K	Mylar 0.01μF ±10%	
C12	CQ92M1H393	Mylar 0.039μF ±10%	
C13	CK45B1H102K	Mylar 0.001μF ±10%	
C14	CC45UJ1H020C	Ceramic 2pF ±0.25pF	
C15	CC45TH1H100D	Ceramic 10pF ±0.5pF	
C16,17	CK45B1H221K	Ceramic 220pF ±10%	
C18	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C19	CC45CH1150J	Ceramic 15pF ±5%	
C20	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C21	CC45SL1H101J	Ceramic 100pF ±5%	
C22	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C23～25	CC45CH1H330J	Ceramic 33pF ±5%	
C26,27	CK46F1H103Z	Ceramic 0.01μF +80,−20%	
C28,29	CC45TH1H150J	Ceramic 15pF ±5%	
C30	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C31	CK45B1H102K	Ceramic 100pF ±10%	
C32	CE04W1C100	Electrolytic 110μF 16WV	
C33	CC45CH1H050C	Ceramic 5pF ±0.25pF	
C34	CC45TH1H080D	Ceramic 8pF ±0.5pF	
C35	CC45CH1HOR5C	Ceramic 0.5pF ±0.25pF	
C36	CC45TH1H120J	Ceramic 12pF ±5%	
C37	CC45CH1HOR5C	Ceramic 0.5pF ±0.25pF	
C38	CC45TH1H120J	Ceramic 12pF ±5%	
C39	CC45CH1H270J	Ceramic 27pF ±5%	
C40	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C41	CK45B1H102K	Ceramic 0.001μF ±10%	
C42	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C43	CK45B1H102K	Ceramic 0.001μF ±10%	
C44	CC45CH1H070D	Ceramic 7pF ±0.5pF	
C45	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C46,47	CK45B1H102K	Ceramic 0.001μF ±10%	
C48	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C49	CC45CH1H330J	Ceramic 33pF ±5%	
C50	CE04W1A470	Electrolytic 47μF 100WV	
C51～54	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C55	CE04W1C220	Electrolytic 22μF 16WV	
C56,57	CC45SL2H150J	Ceramic 15pF ±5%	
C58,59	CC45SL2H680J	Ceramic 68pF ±5%	
C60	CC45SL2H150J	Ceramic 15pF ±5%	
C61	CC45SL2H270J	Ceramic 27pF ±5%	
C62	CC45SL2H330J	Ceramic 33pF ±5%	
C63	CC45SL2H220J	Ceramic 22pF ±5%	
C64～67	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C68	CC45CH1H010C	Ceramic 1pF ±0.25pF	
C69	CK45B1H102K	Ceramic 0.001μF ±10%	
C70	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C71	CC45CH1H330J	Ceramic 33pF ±5%	
C72	CC45RH1H070D	Ceramic 7pF ±0.5pF	
C73	CC45LH1H150J	Ceramic 15pF ±5%	
C74	CC45CH1H050C	Ceramic 5pF ±0.25pF	
C75	CC45CH1H220J	Ceramic 22pF ±5%	
C76	CC45RH1H070D	Ceramic 7pF ±0.5pF	
C77,78	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C79,80	CK45B1H102K	Ceramic 0.001μF ±10%	
C81,82	CM93F2A080D	Mica 8pF ±0.5pF	
C83	CC45SL1H010C	Ceramic 1pF ±0.25pF	
C84	CC45CH1H220J	Ceramic 22pF ±5%	
C85	CC45CH1H020C	Ceramic 2pF ±0.25pF	
C86	CC45CH1H180J	Ceramic 18pF ±5%	
C87	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C88	CK45B1H102K	Ceramic 0.001μF ±10%	
C89	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C91	C91-0405-05	Trough type capacitor 0.001μF	
C92	CK45B1H221K	Ceramic 220pF ±10%	
C93,94	CQ92M1H223K	Mylar 0.022μF ±10%	
C95	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C96	CK45B1H471K	Ceramic 470pF ±10%	
C97	CC45SL1H151J	Ceramic 150pF ±5%	
C98	CC45CH1H150J	Ceramic 15pF ±5%	
C99	CQ92M1H223K	Mylar 0.022μF ±10%	
C101	CK45B1H471K	Ceramic 470pF ±10%	
C102	CQ92M1H103K	Mylar 0.01μF ±10%	
C103	CK45B1H471K	Ceramic 470pF ±10%	
C104,105	CQ92M1H223K	Mylar 0.022μF ±10%	
C106	CK45B1H471K	Ceramic 470pF ±10%	
C107	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C108	CQ92M1H153K	Mylar 0.015μF ±10%	
C109	CC45CH1H470J	Ceramic 47pF ±5%	
C110,111	CK45B1H471K	Ceramic 470pF ±10%	
C112	CQ92M1H472K	Mylar 0.0047μF ±10%	
C113,114	CK45B1H471K	Ceramic 470pF ±10%	
C115	CQ92M1H102K	Mylar 0.001μF ±10%	
C116	CQ92M1H473K	Mylar 0.047μF ±10%	
C117	CQ92M1H223K	Mylar 0.022μF ±10%	
C118	CQ92M1H102K	Mylar 0.001μF ±10%	
C119	CQ92M1H222K	Mylar 0.0022μF ±10%	
C120	CQ92M1H393K	Mylar 0.039μF ±10%	
C121	CQ92M1H222K	Mylar 0.0022μF ±10%	
C122	CQ92M1H103K	Mylar 0.01μF ±10%	
C123	CS15E1V0R1M	Tantalum 0.1μF 16WV	
C124	CQ92M1H333K	Mylar 0.033μF ±10%	
C125	CQ92M1H222K	Mylar 0.0022μF ±10%	
C126	CS15E1C4R7M	Tantalum 4.7μF 16WV	
C127	CE04W1H3R3	Electrolytic 3.3μF 50WV	
C128	CK45F1H103Z	Ceramic 0.01μF +80,−20%	

PARTS LIST

Ref. No.	Parts No.	Description	Re-marks
C129	CQ92M1H103K	Mylar 0.01μF ±10%	
C130	CQ92M1H332K	Mylar 0.0033μF ±10%	
C131	CQ92M1H273K	Mylar 0.027μF ±10%	
C132	CE04W1H010	Electrolytic 1μF 50WV	
C133	CE04W1C100	Electrolytic 10μF 16WV	
C134	CE04W1A470	Electrolytic 47μF 10WV	
C135	CE04W1C100	Electrolytic 10μF 16WV	
C136	CE04W1A101	Electrolytic 100μF 10WV	
C138,139	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C140	CE04W1C220	Electrolytic 22μF 16WV	
C141	CK451H103Z	Ceramic 0.01μF +80,−20%	
C142	CE04W1C100	Electrolytic 10μF 16WV	
C143	CE04W1A470	Electrolytic 47μF 10WV	
C144～147	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C148	CE04W1C220	Electrolytic 22μF 16WV	
C149	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C150	CE04W1C220	Electrolytic 22μF 16WV	
C151	C91-0405-05	Trough type capacitor 0.001μF	
C152	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C153	CC45SL1H330J	Ceramic 33pF ±5%	
C154	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C155	CE04W1C101Q	Electrolytic 100μF 16WV	
C156	CC45CH1H050C	Ceramic 5pF ±0.25pF	
C157～159	CC45TH1H020C	Ceramic 2pF ±0.25pF	
RESISTOR			
R29	RS14GB3D3R3J	Resistor (Metal Film) 3.3Ω	
SEMICONDUCTOR			
Q1	V03-0039-05	IC TA7061AP	
Q2,3	V03-0079-05	Transistor 2SC460 (B)	
Q4,5	V09-0012-05	FET 2SK19 (GR)	
Q6	V09-1002-56	FET 3SK74 (L)	
Q7	V03-2053-06	Transistor 2SC2053	☆
C8,9	V09-1002-56	FET 33K74 (L)	
Q10～17	V03-0079-05	Transistor 2SC460 (B)	
Q18～22	V03-1815-06	Transistor 2SC1815 (Y)	
Q23,24	V03-0336-05	Transistor 2SC496 (Y)	
Q25	V01-1015-06	Transistor 2SA1015 (Y)	
Q27	V03-1959-06	Transistor 2SC1959 (Y)	☆
Q28～30	V03-1815-06	Transistor 2SC1815 (Y)	
Q31	V01-0113-05	Transistor 2SA496 (Y)	
D1～5	V11-0317-05	Diode 1S2208	
D6	V11-0076-05	Diode 1S1555	
D7	V11-5260-16	Diode MI402	
D8	V11-0414-05	Diode 1S2588	
D9～12	V11-0051-05	Diode 1N60	
D13～16	V11-0076-05	Diode 1S1555	
D17～20	V11-0051-05	Diode 1N60	
D21	V11-0076-05	Diode 1S1555	
D22	V11-1262-06	Varistor 1S1212	
D23	V11-4163-56	Zener diode XZ-088	
D24	V11-0076-05	Diode 1S555	
D25	V11-0247-05	Zener diode WZ-100	
D26	V11-0076-05	Diode 1S1555	
D27	V11-0243-05	Zener diode WZ-061	
D28	V11-0076-05	Diode 1S1555	
POTENTIOMETER			
VR1,2	R12-1404-05	Potentiometer P6-S3NA 4.7kΩ	
VR3	R12-0406-05	Potentiometer P6-S3NA 470Ω	
VR4	R12-1404-05	Potentiometer P6-S3NA 4.7kΩ	
VR5	R12-0406-05	Potentiometer P6-S3NA 470Ω	
VR6	R12-5403-05	Potentiometer P6-S3NA 100kΩ	
VR7	R12-4404-05	Potentiometer P6-S3NA 68kΩ	
VR8	R12-1404-05	Potentiometer P6-S3NA 4.7kΩ	
VR9	R12-0406-05	Potentiometer P6-S3NA 470Ω	
TRIMMER			
TC1	C05-0062-05	Ceramic trimmer 6pF ECV1ZW6P	
TC2	C05-0013-15	Ceramic trimmer 20pF ECV1ZW20P	
COIL/INDUCTOR/CRYSTALQUARTZ			
L1	L40-1021-03	Ferri inductor 1mH	
L2	L40-1545-06	Ferri inductor 150mH	
L3	L77-0710-05	Crystal quartz (10.7 MHz)	
L4	L33-0615-05	Choke coil 15μH	
L5	L30-0005-05	IFT	
L6	L31-0313-05	IFT	
L7	L40-3391-03	Ferri inductor 3.3μH	
L8	L40-1021-03	Ferri inductor 1 mH	
L9	L31-0344-05	Tuning coil	
L10	L31-0180-05	Tuning coil	
L11,12	L31-0267-05	Tuning coil	
L13	L34-0672-05	Tuning coil	
L14	L40-1021-03	Ferri inductor 1 mH	
L15	L34-0814-05	VHF coil 4φ4T	☆
L16	L34-0452-05	VHF coil 3φ6T	
L17	L40-1001-03	Ferri inductor 10μH	
L18	L33-0074-05	Choke coil 0.3μH	
L19	L34-0813-05	VHF coil 4φ3T	☆
L20	L34-0819-05	VHF coil 5φ7T	☆
L21	L34-0816-05	VHF coil 5φ2T	☆
L22	L34-0815-05	VHF coil 5φ1T	☆
L23	L34-0814-05	VHF coil 4φ4T	☆
L24	L34-0817-05	VHF coil 5φ3T	☆
L25	L39-0052-05	Inspecting coil	
L26	L33-0002-05	Choke coil 1μH	
L27	L34-0818-05	VHF coil 5φ4T	☆
L28	L33-0025-05	Choke coil 1μH	
L29,30	L34-0694-05	Tuning coil	
L31	L34-0812-012	Tuning coil	☆
L32	L79-0451-05	Helical block	☆
L33	L34-0812-05	Tuning coil	☆
L34	L34-0683-05	Tuning coil	☆
L35	L30-0289-05	IFT	
L36	L71-0201-05	Monolitic filter 10F15A	
L37	L30-0289-05	IFT	
L38	L72-0014-05	Ceramic filter SFE-10.7 MA5	
L39	L77-0327-05	Crystal quartz (10.245 MHz)	
L40	L40-1021-03	Ferri inductor 1 mH	
L41	L72-0309-05	Ceramic filter CFT-455FZ	
L42	L30-0504-05	IFT	
L43	L30-0503-05	IFT	
L44	L79-0442-05	Ceramic discri 455-D	
L45	L40-6825-04	Ferri inductor 6.8 mH	
L46	L40-1021-03	Ferri inductor 1 mH	
MISCELLANEOUS			
	E23-0046-04	Terminal (square) × 16	
	E23-0401-05	Terminal (circle)	

PARTS LIST

PLL Unit (X50-1580-10)

Ref. No.	Parts No.	Description			Remarks
CAPACITOR					
C1～6	CK451H103Z	Ceramic	0.01μF	+80,−20%	
C7～12	CJ45B1H102K	Ceramic	0.001μF	±10%	
C13	CC45CH1H100D	Ceramic	10pF	±0.5pF	
C14	CC45CH1H270J	Ceramic	27pF	±0.5%	
C15	CC45UJ1H180J	Ceramic	18pF	±5%	
C16	CK45F1H103Z	Ceramic	0.01μF	+80,−20%	
C17	CE04W1A470	Electrolytic	47μF	10WV	
C18,19	CC45LH1H050C	Ceramic	5pF	±0.25pF	
C20	CE04W1A470	Electrolytic	47μF	10WV	
C21,22	CK45F1H103Z	Ceramic	0.01μF	+80,−20%	
C23	CE04W1C101Q	Electrolytic	100μF	16WV	
C24～26	CK45F1H103Z	Ceramic	0.01μF	+80,−20%	
C27	CC45CH1H330J	Ceramic	33pF	±5%	
C28	CC45CH1H050C	Ceramic	5pF	±0.25pF	
C29	CE04W1H010	Electrolytic	1μF	50WV	
C30	CK45F1H103Z	Ceramic	0.01μF	+80,−20%	
C31	CC45CH1H100D	Ceramic	10pF	±0.5pF	
C32～35	CK45F1H103Z	Ceramic	0.01μF	+80,−20%	
C36	CC45CH1H050C	Ceramic	5pF	±0.25pF	
C37	CK45F1H103Z	Ceramic	0.01μF	+80,−20%	
C38	CS15E1C4R7M	Tantalum	4.7μF	16WV	
C39	CS15E1A100M	Tantalum	10μF	10WV	
C40	CC45CH1H050C	Ceramic	5pF	±0.25pF	
C41	CC45CH1H270J	Ceramic	27pF	±0.5%	
C42	CC45CH1H220J	Ceramic	22pF	±5%	
C43～53	CK45F1H103Z	Ceramic	0.01μF	+80,−20%	
C54	CE04W1E4R7	Electrolytic	4.7μF	25WV	
C55	C90-0246-05	Ceramic	0.01μF	±10%	
C56	CE04W1C100	Electrolytic	10μF	16WV	
C57	CK45F1H103Z	Ceramic	0.01μF	+80,−20%	
C58	CC45SL1H101J	Ceramic	100pF	±5%	
C59	CK45F1H103Z	Ceramic	0.01μF	+80,−20%	
C60,61	CC46CH1H220J	Ceramic	22pF	±5%	
C62	CE04W1A470	Electrolytic	47μF	10WV	
C63,64	CK45F1H103Z	Ceramic	0.01μF	+80,−20%	
C65,66	CQ92M1H332K	Mylar	0.0033μF	±10%	
C67	CQ92M1H103K	Mylar	0.01μF	±10%	
C68	CQ92M1H472K	Mylar	0.0047μF	±10%	
C69	CE04W1H010	Electrolytic	1μF	50WV	
C70	CQ92M1H332K	Mylar	0.0033μF	±10%	
C71	CE04W1A101Q	Electrolytic	100μF	10WV	
C72	CQ92M1H102K	Mylar	0.001μF	±10%	
C73	CK453B1H331K	Ceramic	330pF	±10%	
C74	CQ92M1H472K	Mylar	0.0047μF	±10%	
C75	CE04W1C101Q	Electrolytic	100μF	16WV	
C76	CE04W1C100	Electrolytic	10μF	16WV	
C77	CE04W1A330	Electrolytic	33μF	10WV	
C78	CQ92M1H303K	Mylar	0.039μF	±10%	
C79	CE04W1A330	Electrolytic	33μF	10WV	
C80	CE04W1A101Q	Electrolytic	100μF	10WV	
C81	CQ92M1H104K	Mylar	0.1μF	±10%	
C82	CE04W1C471Q	Electrolytic	470μF	16WV	
C84	CE04W1A470	Electrolytic	47μF	10WV	
C85	CC45CH1H070D	Ceramic	7pF	±0.5pF	
C86	CC45CH1H150J	Ceramic	15pF	±5%	
C87	CC45CH1H030C	Ceramic	3pF	±0.25pF	
C88	CK45F1H103Z	Ceramic	0.01μF	+80,−20%	
C89	CE04W1C100	Electrolytic	10μF	16WV	
C90	CK45B1H102K	Ceramic	0.001μF	±10%	
C91	CC45CH1H030C	Ceramic	3pF	±0.25pF	
C92	CC45UJ2H020C	Ceramic	1pF	±0.25pF	
C93	CC45CH1H080D	Ceramic	8pF	±0.5pF	
C94	CQ92M1H103K	Mylar	0.01μF	±10%	
C95	CC45UJ1H060D	Ceramic	6pF	±0.5pF	
SEMICONDUCTOR					
Q1～5	V03-1815-06	Transistor	2SC1815 (Y)		
Q6	V03-0079-05	Transistor	2SC460 (B)		
Q7,8	V03-1815-06	Transistor	2SC1815 (Y)		
Q9	V03-1959-06	Transistor	2SC1959 (Y)		
Q10	V01-0113-05	Transistor	2SA496 (Y)		
Q11,12	V09-1002-56	FET	3SK74 (L)		
Q13,14	V03-1815-06	Transistor	2SC1815 (Y)		
Q15	V30-1030-46	IC	SM5111A		☆
Q16	V03-1815-06	Transistor	2SC1815 (Y)		
Q17	V03-0272-05	Transistor	2SC1345 (E)		
Q18	V03-1815-06	Transistor	2SC1815 (Y)		
Q19	V30-0087-05	IC	TA7060P		
Q20	V03-1923-06	Transistor	2SC1923 (O)		☆
Q21,22	V03-1815-06	Transistor	2SC1815 (Y)		
Q23,24	V03-2240-06	Transistor	2SC2240 (GR)		
Q25	V30-0208-05	IC	AN315		
Q26	V09-0060-05	FET	2SK30A (GR)		
Q27	V09-1001-16	FET	2SK19 (GR) (T)		
Q28	V03-1923-06	Transistor	2SC1972 (O)		☆
D1～5	V11-0414-05	Diode	1S2588		
D6～10	V11-4161-36	Diode	1SV53A		
D11～20	V11-0076-05	Diode	1S1555		
D21	V11-0374-05	Diode	1SS16		
D22	V11-4161-16	Zener diode	XZ-061		
D23,24	V11-0414-05	Diode	1S2588		
D25	V11-4161-56	Zener diode	WZ-040		☆
D26	V11-0317-05	Diode	1S2208		
POTENTIOMETER					
VR1～5	R12-5403-05	Potentiometer	100kΩ		
VR6,7	R12-1403-05	Potentiometer	1kΩ		
TRIMMER					
TC1	C05-0067-05	Ceramic trimmer	5P		
TC2	C05-0062-05	Ceramic trimmer	6P		
COIL/INDUCTOR					
L1～5	L34-0437-05	Choke coil			☆
L6	L77-0832-05	Crystal quartz	43.7667 MHz		☆
L7	L77-0833-05	Crystal Quartz	44.4333 MHz		☆
L8	L77-0834-05	Crystal Quartz	43.5667 MHz		☆
L9	L77-0835-05	Crystal Quartz	44.2333 MHz		☆
L10	L77-0836-05	Crystal Quartz	44.6333 MHz		☆
L11	L40-1511-03	Ferri-inductor	150μH		
L12	L33-0605-05	Choke coil	0.47μH		
L13	L32-0002-05	Oscillator coil			
L14	L34-0683-05	Tuning coil			
L15	L34-0820-05	Tuning coil			☆
L16	L34-0683-05	Tuning coil			
L17	L77-0720-05	Crystal Quartz	10.240 MHz		
L18	L40-2201-03	Ferri-inductor	22μH		
L19	L40-1091-03	Ferri-inductor	1μH		
L20	L15-0016-05	Choke coil (Low frequency)			
L21,22	L40-1021-03	Ferri-inductor	1mH		
L23	L40-3391-03	Ferri-inductor	3.3μH		
L25	L32-0618-05	Oscillator coil			☆
MISCELLANEOUS					
	E23-0046-04	Terminal × 8 (square)			
	E23-0401-05	Terminal × 2 (circle)			

PARTS LIST/PACKING

CONTROL UNIT (X54-1440-10)

Ref. No.	Parts No.	Description	Re-marks
		CAPACITOR	
C1	CE04W1C470Q	Electrolytic 47μF 16WV	
C2	CE04W1A470	Electrolytic 47μF 10WV	
R1,2	R90-0514-05	Resistor block 10k×7	
R3～5	R90-0516-05	Resistor network	
R6	R90-0515-05	Resistor block 10k×4	
Q1～6	V03-1815-06	Transistor 2SC1815 (Y)	
Q7	V01-1015-06	Transistor 2SC1015 (Y)	
IC1～3	V30-1006-46	IC TC4035BP	☆
IC4～6	V30-0232-26	IC TC4019BP	
IC7～9	V30-0232-76	IC TC5022BP	
IC10,11	V30-1006-36	IC TC4081BP	☆
IC12	V30-1025-26	IC FS7806M	☆
D1～22	V11-0051-05	Diode 1N60	
D23	V11-0076-05	Diode 1S1555	
D24	V11-0307-05	Zenner diode WZ-150	
D25	V11-3162-86	LED TLG205	☆
D26	V11-3162-96	LED TLR205	☆
D27～30	V11-4161-66	LED 513 OK	☆
S1	S29-1406-05	Rotary switch (1 MHz) K	☆
S4	S29-1408-05	Rotary switch (1 MHz) W	☆
S2	S29-1405-05	Rotary switch (1000 kHz, 10 kHz)	☆
S3	S40-2405-05	Push switch (0k, 5k)	
S4	S29-4402-05	Slide rotary (for shift)	☆

TONE UNIT (X52-1110-50) (T TYPE) (X52-1110-61) (W TYPE)

Ref. No.	Parts No.	Description	Re-marks
C1	CD45B1H102K	Ceramic 1000pF ±10%	
C2	CE04W1C220Q	Electrolytic 22μF 16WV	
C3～5	C91-0433-05	Layer-built 0.0039μF ±5%	☆
C6	CE04W1C220Q	Electrolytic 22μF 16WV	
C7,8	CE04W1H010	Electrolytic 1μF 50WV	
C9,10	CK45B1H102K	Ceramic 1000pF ±10%	
C11	CS15E1A150K	Tantalum 15μF ±10%	(T)
C12	CK45B1H102K	Ceramic 1000pF ±10%	
C13	CS15E1A150K	Tantalum 15μF ±10%	(T)
		RESISTOR	
R1～12	RD14CB2E○○○J But	Carbon ○○○Ω ±5% 1/W	
R2,3	R92-0616-05	Metal film 10kΩ ±1% 1/W	☆
R4	R92-0617-05	Metal film 7.5kΩ ±1% 1/W	☆
R5	RN14BK2E4703F	Metal film 470kΩ ±1% 1/W	
R10	RD14CB2E102J	Carbon 15kΩ ±5% 1/W	(T)
		SEMICONDUCTOR	
Q1,2		Transistor 2SC458 (B)	
D1,2		Diode 1S1555	(T)
D1		Diode 1S1555	(W)
		POTENTIOMETER	
VR1	R12-2405-05	Semi-fixed resistor 5kΩ	☆
VR2	R12-4403-05	Semi-fixed resistor 50kΩ	(T)☆
		MISCELLANEOUS	
—	E40-0464-05	Pin plug	

PACKING

ACCESSORIES SUPPLIED

1. Dynamic microphone equipped with
   5-pin plug (T91-0310-05) (K)..... 1 piece
   4-pin plug (T91-0301-05) (T)
   4-pin plug (T91-0302-05) (W)
2. Mounting bracket (J21-2608-03)..... 1 piece
3. Mounting parts
   Hex. socket screws (N99-0304-04)..... 4 pieces
   Screws, 6 mm diameter (N09-0008-04)..... 4 pieces
   Plain washers, 6 mm diametr (N15-1060-46)..... 4 pieces
   Spring washers, 6 mm diameter (N16-0060-41)..... 4 pieces
   Nuts, 6 mm diameter (N14-0009-04)..... 4 pieces
4. Snap-lock (J51-0006-15)..... 2 pieces
5. Label..... 1 sheet
6. Spare fuse, 4A (F05-1031-05)..... 1 piece
7. DC power cord with plug and fuse..... 1 piece
8. Miniature plug for external speaker (E12-0001-05) and touch tone pad (E08-0471-05)..... 2 pieces (E09-0471-05)
9. Operating manual (B50-2614-00) (K)..... 1 copy
   (B50-2628-00) (W)
   (B50-2629-00) (T)

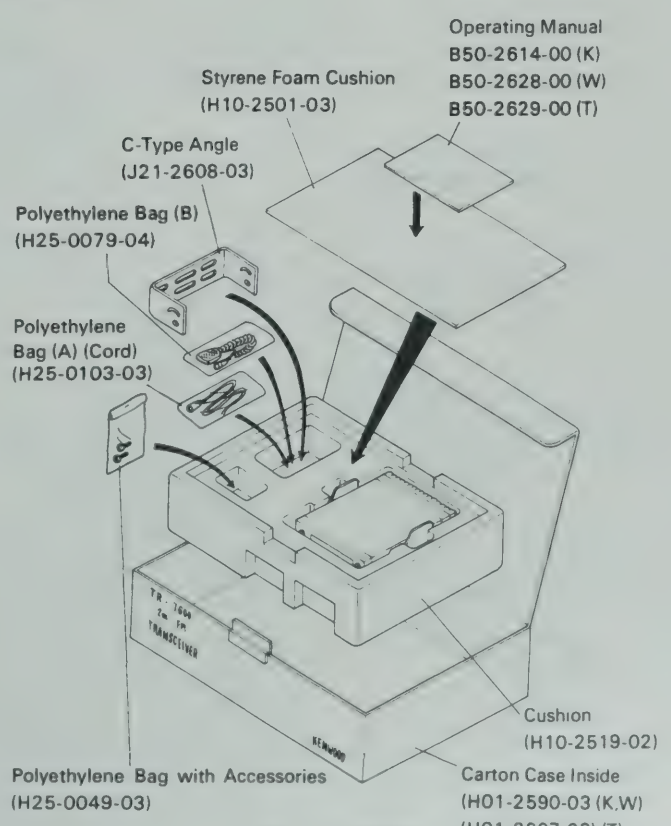


Fig. 9 Packing

EXPLODED VIEW

I. Removing the case
(1) Remove the bind screws ① ~ ⑪ .
(2) Remove the upper and 2 lower cases.

II. Removing the panel
(1) Remove the knobs.
(2) Remove the screws Ⓐ ~ Ⓓ

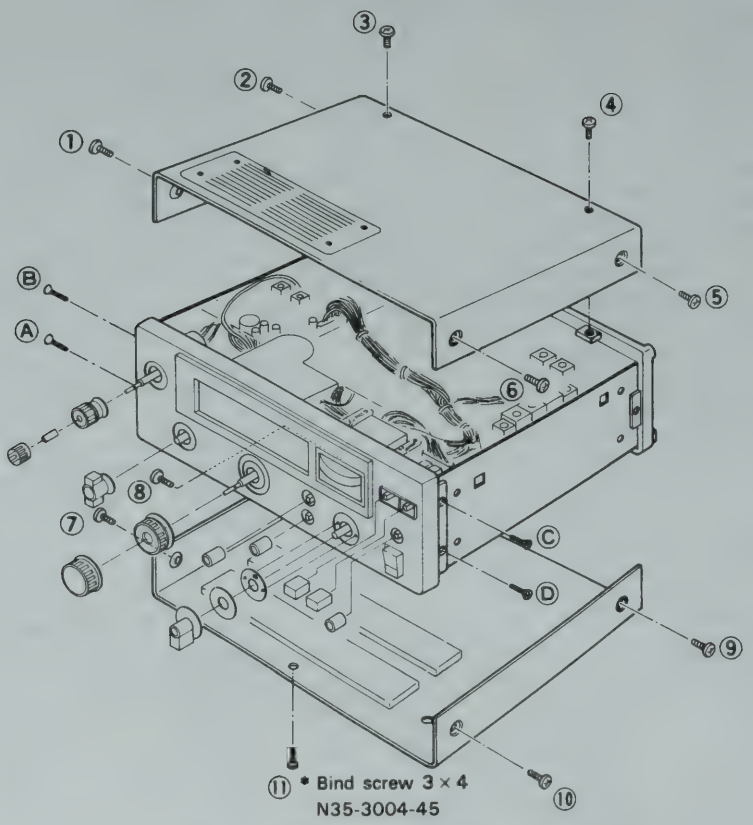


Fig. 10 Removing the Panel and Case

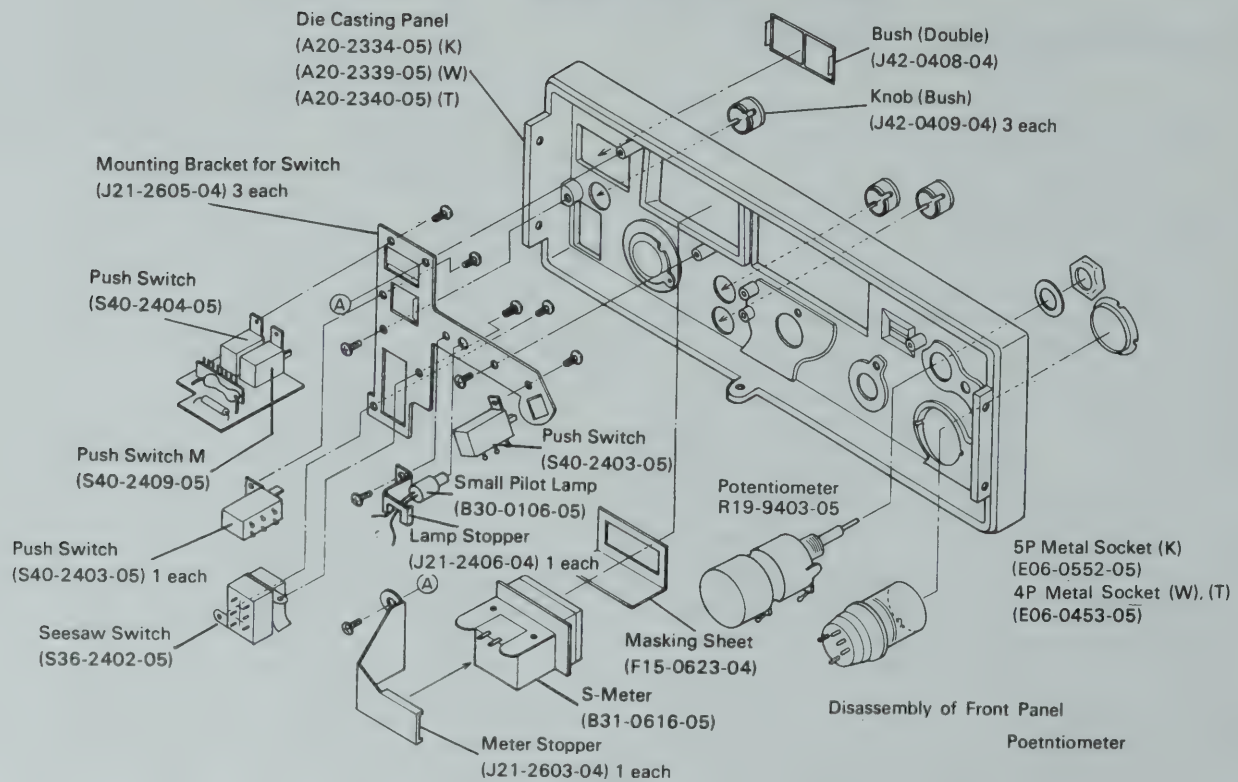
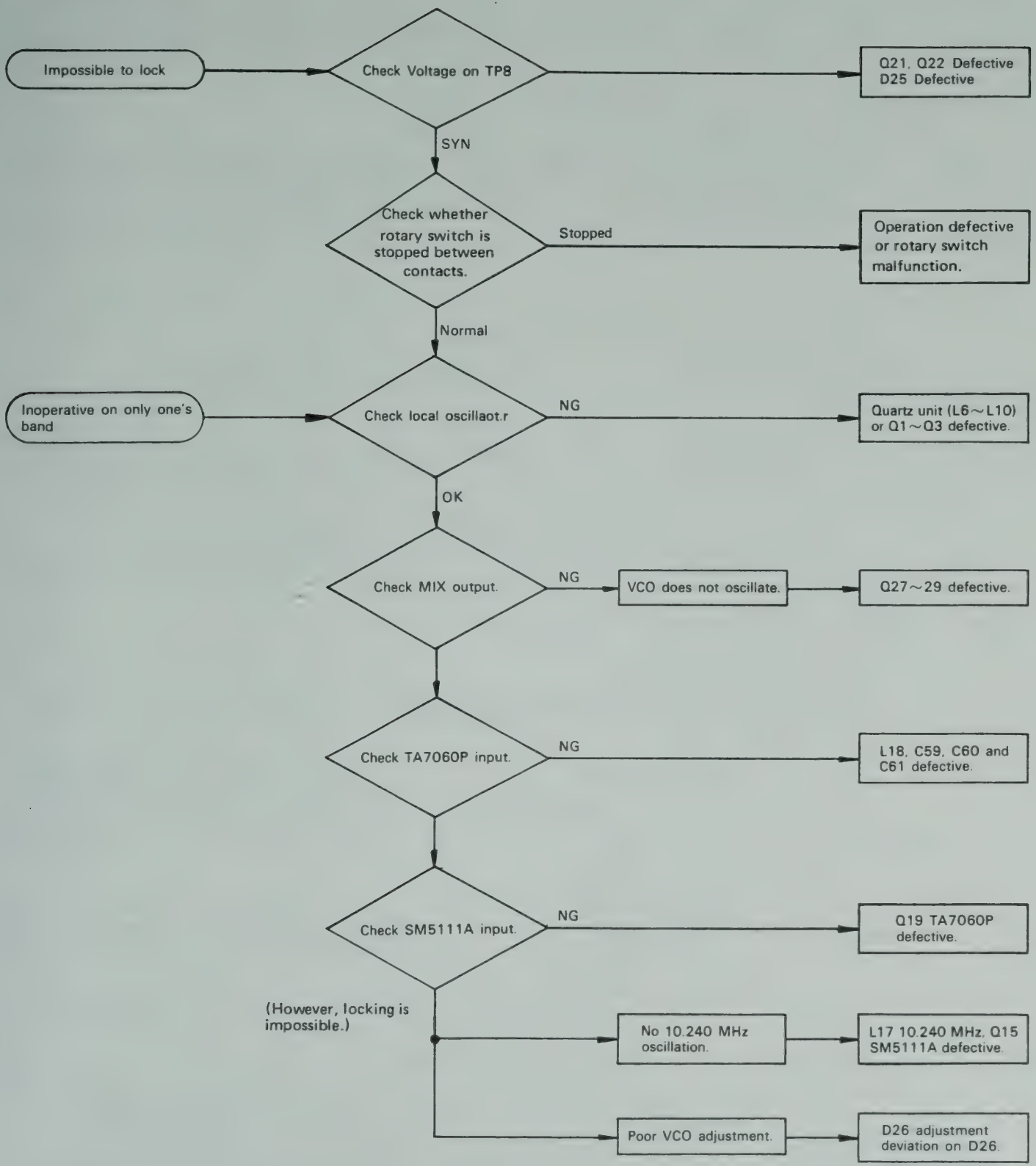


Fig. 11 Disassembly of Front Panel

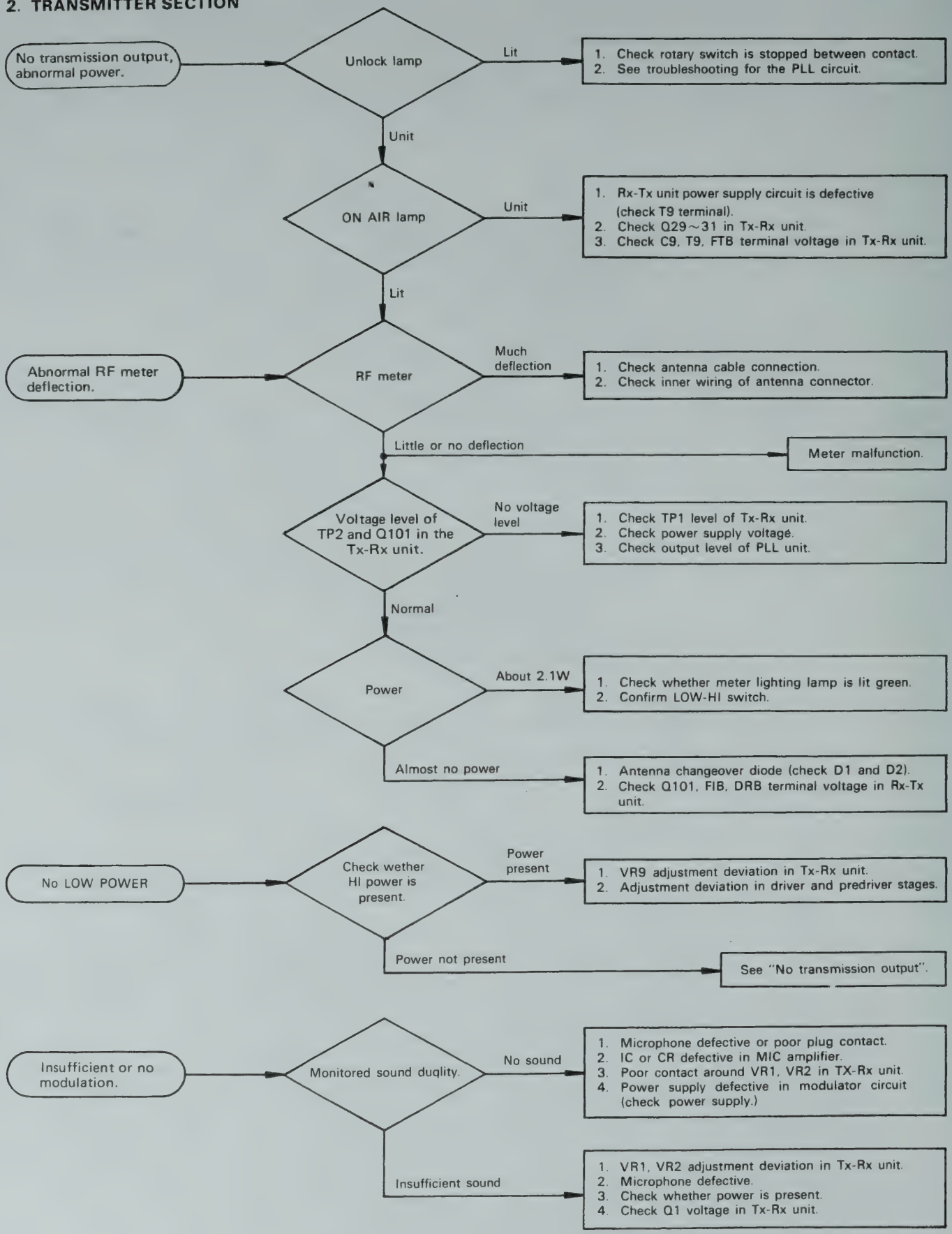
TROUBLESHOOTING

1. PLL CIRCUIT



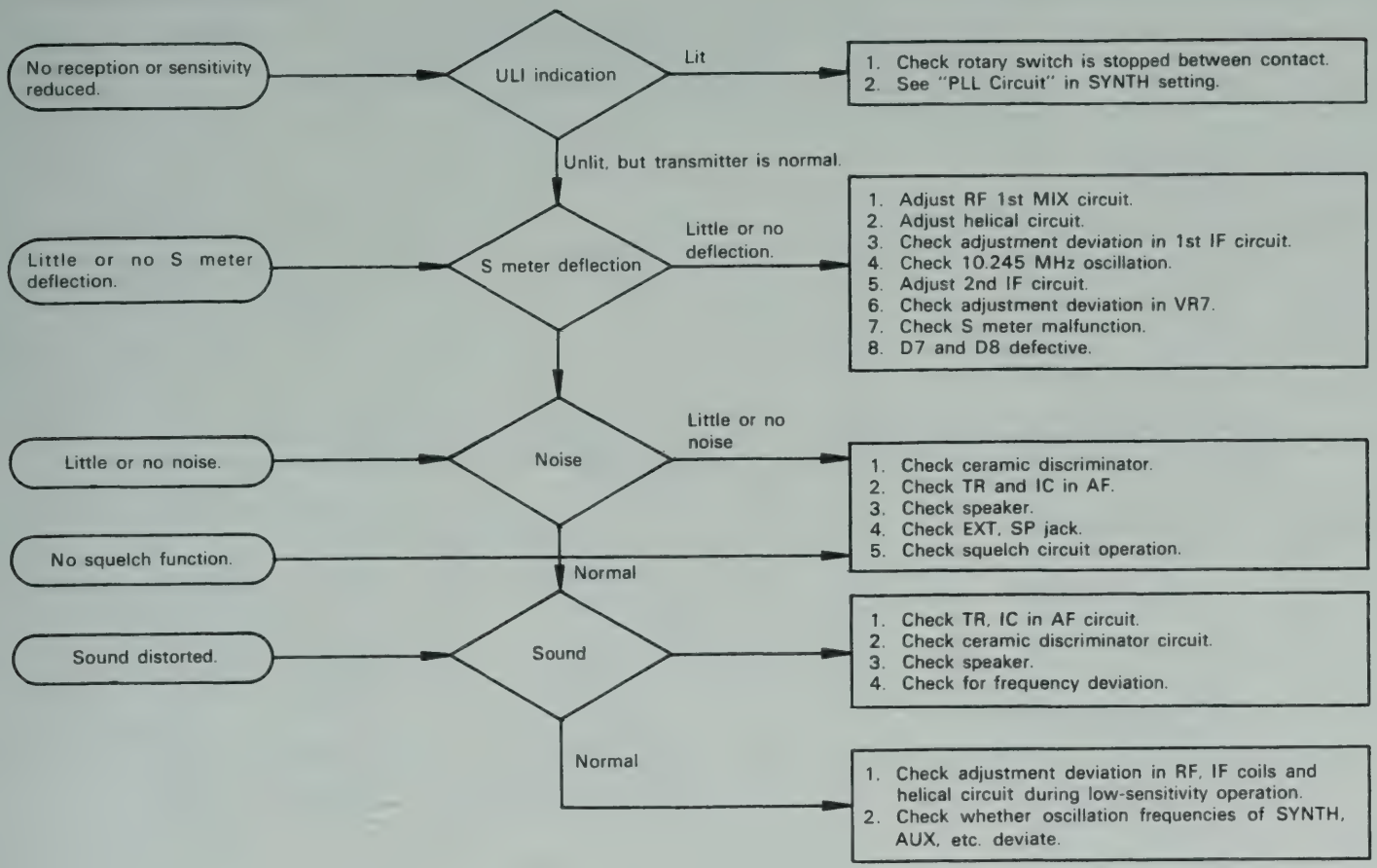
TROUBLESHOOTING

2. TRANSMITTER SECTION



TROUBLESHOOTING/ADJUSTING

3. RECEIVER SECTION



ADJUSTMENT

TEST EQUIPMENT REQUIRED

1. DC Power Supply
- Voltage: Variable from 9 to 16 V.
- Current: 4 A min.

2. DC Voltmeter
- Voltage range: 10 V～16 V (min.)
- Input inpedance: Sufficient (1MΩ/VDC)

3. RF Valve Voltmeter
- Voltage range: F.S. 10 mV～300 V
- Measuring frequency: 200 MHz min.
- Input impedance: 1 MΩ min., 3 pF max.

4. Frequency Counter
- Measuring frequency: 150 MHz min.
- Min. input sensitivity: about 50 mV

5. Oscilloscope:
With horizontal input terminal and high sensitivity,
- Measuring frequency: 3 MHz min.

6. Power Meter
- Measuring frequency: 150 MHz min.
- Impedance: 50Ω
- Measuring range: 20W, 3W

7. Linear Detector

8. AG
- Frequency range: 300 Hz～5 kHz
- Output: 0.5 mV～1 V

9. AF Valve Voltmeter
- Measuring frequency: 50 Hz 10 kHz
- Input impedance: 1 MΩ min.
- Voltage range: F.S. 3 mV～30 V

10. SSG
- Output frequency: Capable of covering 144 MHz ～148 MHz
- Modulation: Frequency modulation is possible.

11. Sweep Generator
- Frequency range: Capable of covering 144 MHz ～148 MHz

12. Dummy
8Ω 5W (approx.)

13. Directional Coupler

14. Detector

ADJUSTMENT

1. Adjustment of PLL circuit

Item	Condition	Measuring point			Adjusting point			Reference	Remarks
		(Measure instruments)	Unit	Terminal	Unit	Parts	Method		
1. Voltage check and adjustment	1) POWER SW: ON HI/LOW SW: HI MR SW: OFF MODE SW: S MHz SW: 6 100 kHz SW: 0 10 kHz SW: 0 SUBTONE SW: O 5Hz SW: 0 REMOTE SW OFF SEND/REC. SW: SEND	DC V.M	PLL	T9 (J1)				8.9V～10.2V	Confirm
			TX.RX	T9				8.9V～10.2V	Confirm
				EB				Approx. 12V	Confirm
	2) SEND/REC SW: REC	DC V.M	TX.RX	R9				7.7V～8 3V	Confirm
	3) Same as above.	DC V.M	PLL	TP3	PLL	VR7	8.0V	±0.2V	
	4) Same as item 2)	DC V.M	PLL	TP8	PLL	VR6	6.0V	±0.2V	
2 PLL	1) 100 kHz SW: 0 10 kHz SW: 0	RF V.M	PLL	TP1	PLL	L13	Turn the L13 core counter clockwise (180°) from the oscillation start point	0 46V	
				TP7		L14 L16	MAX	1.4V	
	2) MHz SW 4	DC V.M	PLL	TP5	PLL	TC2	1.5V	±0 05V	
	3) MHz SW: 7 100 kHz SW: 9 10 kHz SW. 9	DC V.M	PLL	TP5				Less than 5.5V	Confirm
	4) Same as above	F.Count	PLL	TP6	PLL	TC1	10.24000 Hz	±100 Hz	
	5) MHz SW: 4 100 kHz SW: 0 10 kHz SW: 0 5 kHz SW. 5 kHz	Frequency Counter	PLL	TP4	PLL	L1	133 3050 MHz	±100 Hz	
	6) MHz SW. 6					L2	135.3050 MHz	±100 Hz	
	7) MHz SW 5 MODE SW: ⊖					L3	133.7050 MHz	±100 Hz	
	8) MHz SW 7					L4	135.7050 MHz	±100 Hz	
	9) MODE SW: ⊕					L5	136.9050 MHz	±100 Hz	
Calibration of counter at 10.24 MHz	When a frequency counter is connected to the TP6 of the PLL unit, the 10.24 MHz signal is devited because of the impedance, so the counter should be calibrated using the following procedure MHz SW. 4 100 kHz SW: 0 10 kHz SW. 0 ↓ MHz SW: 5	Frequency Counter	PLL	TP4	PLL	TC1	With the MHz SW set to "4" and "5" check that the signal on the TP6 is 10.24 MHz at each position when the TC1 is adjusted so that the signal of 100 Hz order on the TP4 remains unchanged.		
	10) MHz SW: 4 5 kHz SW. 0 MODE SW: S SEND/REC SW: REC		PLL	TP4	PLL	VR1	133 3000 MHz	±100 Hz	
	11) MHz SW: 6					VR2	135.3000 MHz	±100 Hz	
	12) MHz SW: 5 MODE SW: ⊖ SEND/REC. SW: SEND					VR3	133.7000 MHz	±100 Hz	
	13) MHz SW: 7					VR4	135.7000 MHz	±100 Hz	
	14) MODE SW: ⊕ Recheck the frequencies in Item (5) through (9). If they are devited, readjust L1 through L5					VR5	136 9000 MHz	±100 Hz	

ADJUSTMENT

Item	Condition	Measuring point			Adjusting point			Reference	Remarks
		(Measure instruments)	Unit	Terminal	Unit	Parts	Method		
	15) MHz SW: 5 100 kHz SW: 9 10 kHz SW: 9 MODE SW: S SEND/REC. SW: REC		PLL	TP4				135.2900 MHz±100 Hz	Confirm
	16) MHz SW: 7							137.2900 MHz ±100 Hz	Confirm
	17) MHz SW: 5 MODE SW: ⊖ SEND/REC. SW: SEND							134.6900 MHz±100 Hz	Confirm
	18) MHz SW: 7							136.6900 MHz±100 Hz	Confirm
	19) MHz SW: 4 100 kHz SW: 0 10 kHz SW: 0							132.7000 MHz±100 Hz	Confirm
	20) MHz SW: 6	Frequency Counter	PLL	TP4				134.7000 MHz±100 Hz	Confirm
	21) MHz SW: 5 SEND/REC. SW: REC.							134.3000 MHz±100 Hz	Confirm
	22) MHz SW: 7							136.3000 MHz±100 Hz	Confirm
	23) MHz SW: 6 MODE SW: ⊕							135.9000 MHz±100 Hz	Confirm
	24) MHz SW: 7 SEND/REC. SW: REC.							136.3000 MHz±100 Hz	Confirm
	25) MHz SW: 4 SEND/REC. SW: SEND & REC.							133.3000 MHz±100 Hz	Confirm
	26) MHz SW: 5 SEND/REC. SW: SEND & REC.							134.3000 MHz±100 Hz	Confirm
	27) MHz SW: 4→5→6→7→4 MODE SW: S SEND/REC. SW: REC.		PLL	TP4				The frequency should become higher than 133.3000 MHz in 1 MHz steps and should return to the original frequency at the "4" position.	Confirm
	28) 100 kHz SW: 0 → 1 → ..... 9 → 0							The frequency should become higher than 133.3000 MHz in 100 kHz steps and should return to the original frequency at the "0" position.	Confirm
	29) 10 kHz SW: 0 → 1 → ..... 9 → 0							The frequency should become higher than 133.3000 MHz in 10 kHz steps and should return to the original frequency at the "0" position.	Confirm
	30) MHz SW: 6 SEND/REC. SW: SEND	RF V.M	PLL	TP4	PLL	L15	MAX		
3. Paint lock	1) L1. L2. L3. L4 L5. L13								

ADJUSTMENT

2. Adjustment of TX section

Item	Condition	Measuring point			Adjusting point			Reference	Remarks
		(Measure instruments)	Unit	Terminal	Unit	Parts	Method		
1. SET	1) POWER SW: ON HI/LOW SW: HI MR SW: OFF MODE SW: S MHz SW: 4 100 kHz SW: 0 10 kHz SW: 0 5 kHz SW: 0 SUBTONE SW: OFF REMOTE SW: OFF SEND/REC. SW: SEND TC 1: Centered TC 2: Centered VR8: Full counter clockwise (FCCW)								
2. 10.7 MHz	1) Ready for UNLOCK	RF V.M	TX.RX	TP1	TX.RX	L5,L6	MAX	0.4 V	
	2) Same as above	F.Counter	TX.RX	TP1	TX.RX	TC1	10.7000 MHz	±100 Hz	
3. VCT	1) Ready for UNLOCK MHz SW: 4 → 5 → 6 → 7	DC V.M	TX.RX	TP3				Check voltage goes down step by step	Confirm
4. B P F DRIVE	1) MHz SW: 6	RF V.M	TX.RX	gate	TX.RX	L9. 10 L11. VR3	MAX Repeat the same procedure two or three times.	1.2 V	Adjust the setting range of RF voltmeter for peak value.
	2) MHz SW: 7 100 kHz SW: 9 10 kHz SW: 9	RF V.M	TX.RX	TP2	TX.RX	L12. 13	Repeat the same procedure two or three times.		
	3) MHz SW: 4 100 kHz SW: 0 10 kHz SW: 0	RF V.M.	TX.RX	RFI	TX.RX	L13	MAX		Use to RF prove 100 : 1
5. POWER	1) POWER SW: OFF Power module lead: Soldering a RFT terminal.								
	2) MHz SW: 6 100 kHz SW: 0 10 kHz SW: 0 POWER SW: ON	POWER METER	rear panel	ANT.	TX.RX	TC2	MAX		
	3) Same as above	POWER. M DC A.M			TX.RX	L19	Adjust for 12W (if the power is less than 12 W make adjustment according to the procedure in Item (4) below.	Less than 3.0A	
	4) Same as above	POWER M DC A.M			TX.RX	TC2	Adjust L19 to increase to capacity		
	5) MHz SW: 4	POWER M DC A.M						More than 10 W	Confirm
	6) MHz SW: 7 100 kHz SW 9 10 kHz SW: 9	POWER M DC A.M						More than 10 W Less than 3 A	Confirm
6. RF METER	1) MHz SW: 6 100 kHz SW: 0 10 kHz SW. 0 TX.RX unit VR6: Center	RF METER	front panel		TX.RX	L21 L22	Adjust L22 so that meter indicates "8" on the scale		
	2) Same as above	RF METER			TX.RX	VR6	Meter indicates "8".		
7. LOW POWER	1) HI/LOW SW: LOW	POWER M panel			TX.RX	VR9	1.2W	Check that the meter lamp changes from to green.	
	2) MHz SW: 4	POWER M						0.8 W ~ 1.5 W	
	3) MHz SW: 7 100 kHz SW. 9 10 kHz SW 9	POWER.M	rear panel	ANT.				0.8W ~ 1.5W Power check output	Confirm

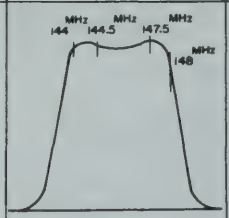
ADJUSTMENT

Item	Condition	Measuring point			Adjusting point			Reference	Remarks
		(Measure instruments)	Unit	Terminal	Unit	Parts	Method		
8. Output at the 11.5V (power supply)	1) DC Terminal: 11.5 V	POWER METER	rear panel	ANT.				Power check output	Confirm
	2) MHz SW: 6 10 kHz SW: 0 100 kHz SW: 0							Check power output	Confirm
	3) MHz SW: 4							Check power output	Confirm
	4) HI/LOW SW: HI							More than 6.0W	Confirm
	5) MHz SW: 6							More than 6.0W	Confirm
	6) MHz SW: 7 100 kHz SW: 9 10 kHz SW: 9							More than 6.0W	Confirm
9. Frequency SET	1) DC Terminal: 13.8V	Frequency Counter	rear panel	ANT M coupling	TX.RX	TC1	146.000 MHz	±200 Hz	
	2) MHz SW: 6 100 kHz SW: 0 10 kHz SW: 0								
10. Protection	1) Connect the Power Meter to the ANTENNA	DC V.M	TX.RX	TP4	TX.RX	VR5	MIN		
	2) Disconnect the Power to the ANTENNA TX.RX unit VR8: near centered	DC A.M	front panel		TX.RX	VR8	1.2A Check that the power is decrease when the power meter is disconnected.		
	3) MHz SW: 4	DC A.M						Approx. 1.2A	Confirm
	4) MHz SW: 7 100 kHz SW: 9 10 kHz SW: 9	DC A.M					Approx. 1.2A	Approx. 1.2A	Confirm
	5) Connect the power meter to the ANTENNA.	POWER.M	rear panel	ANT				Power output go on again	Confirm
11. Deviation	1) MHz SW: 6 100 kHz SW: 0 10 kHz SW: 0 AG OUTPUT: 30 mV/ 1 kHz	Linear Detector			TX.RX	VR2	5.0 kHz		
	2) AG OUTPUT: 3 mV/ 1 kHz	Linear Detector			TX.RX	VR1	3.5 kHz		
12. SUBTONE	1) MIC Terminal: OPEN SEND/REC. SW: SEND AG OUTPUT: 300 mV/ 1 kHz SUBTONE SW: ON	Linear Detector		SUB G >AG TB.. DC V.M				1) Check that output waveform from the Linear Detector 2) Confirm that TV Terminal Voltage is approx. 10V	Confirm
13. Abnormal Oscillation	1) Same as above	Linear Detector						Very the power voltage from 11.5 to 16 V for each item to check for abnormal oscillation	
	2) HI/LOW SW: LOW								
	3) MHz SW: 4								
	4) HI/LOW SW: HI								
	5) MHz SW: 7 100 kHz SW: 9 10 kHz SW: 9								
	6) HI/LOW SW: LOW								
14. Shift & Memory Shift	1) MHz SW: 5 100 kHz SW: 0 10 kHz SW: 0 5 kHz SW: 0 HI/LOW SW: HI DC terminal: 13.8V MODE SW: ⊖ SEND/REC. SW: SEND MR SW: OFF	F.Count	rear panel	ANT. M coupling				144.400 MHz	
	2) MODE SW: ⊕	F.Count	rear panel	ANT				145.000 MHz	Confirm
	3) MHz SW: 7 MODE SW ⊖	F.Count	rear panel	ANT				146.400 MHz	Confirm
	4) MODE SW ⊕	F.Count	rear panel	ANT				147.600 MHz	Confirm
	5) MODE SW: S M SW (NON-LOCK): ON								Confirm

ADJUSTMENT

Item	Condition	Measuring point			Adjusting point			Reference	Remarks
		(Measure instruments)	Unit	Terminal	Unit	Parts	Method		
	6) MHz SW: 4 MODE SW: M (green)	F.Count	rear panel	ANT.				147.000 MHz Check that indication "7.000".	Confirm
	7) MODE SW: S	F.Count	rear panel	ANT.				144.000 MHz	Confirm
	8) MR SW: ON	F.Count	rear panel	ANT.				147.000 MHz Check that indication "7.000".	Confirm
15. Paint lock	1) L10, L11, L12, L13								

3. Adjustment of Receiver section

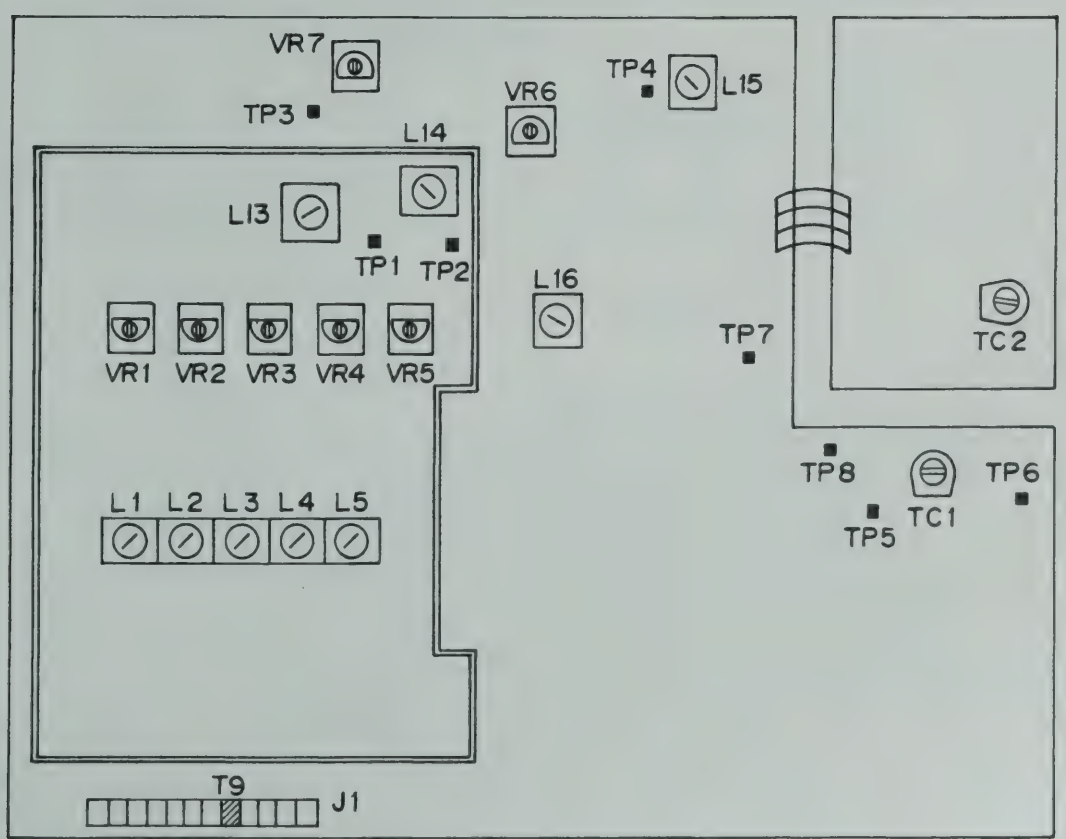
Item	Condition	Measuring point			Adjusting point			Reference	Remarks
		(Measure instruments)	Unit	Terminal	Unit	Parts	Method		
1. SETTING	1) POWER SW: ON HI/LOW SW: LOW MR SW: OFF MODE SW: S MHz SW: 5 100 kHz SW: 9 10 kHz SW: 5 5 kHz SW: 0 SUBTONE SW: OFF REMOTE SW: ON SEND/REC. SW: REC. SQUELCH VR: MIN EXT SP (terminal): AF V.M (8Ω) Oscilloscope								
2. Herical block	1) ANT terminal: SWEEP Oscilloscope VERT.GAIN: MAX	Oscillo- scope (Detector)	TX.RX	TP5	TX.RX	L29.30 L31 L32 (abc) (L33)	Adjust for a maximum gain and for a waveform as shown at right. Adjust L29 and L30 for a maximum waveform. Adjust L31, L32 (a.b.c) and L33 for a proper bandwidth and optimum waveform.	 Adjust L29 and L30 the waveform is distroted as shown below 	Repeat
3. IF GAIN	1) REMOTE SW: OFF ANT UNIT: SSG (DEV.: 5 kHz MOD 1 KHz SSG OUTPUT Approx. 10 dB AF VR: 0.63 V/8Ω	AF V.M					Adjust SSG for correct frequency and set it to optimum waveform.		
	2) SSG OUTPUT: 5～10 dB	S METER			TX RX	L34,35 L37	MAX. Repeat the same procedure two or three times		
4. S METER	1) SSG OUTPUT: 30 dB	S METER			TX.RX	VR7	Set the scale 10 (30 V)	30 dB±4 dB	
5. Discriminator	1) SSG OUTPUT: 0 dB	AF V.M			TX RX	L43	MAX		

ADJUSTMENT/PC BOARD ALIGNMENT

Item	Condition	Measuring point			Adjusting point			Reference	Remarks
		(Measure instruments)	Unit	Terminal	Unit	Parts	Method		
6. S/N (Signal to Noise ratio)	1) SSG OUTPUT: −6 dB 2) MHz SW: 4 100 kHz SW: 0 10 kHz SW: 0	AF V.M					With a signal received at each channel, set AF V.M to 0.63 V/8 . Next turn the SSG modulation OFF and measure the attenuation by AF V.M.	S/N 20 dB	Confirm
	3) MHz SW: 7 100 kHz SW: 9 10 kHz SW: 9	AF V.M					With a signal received, set AF V.M to 0.63V/8Ω. Next, turn the SSG modulation by AF V.M.	S/N 20 dB	Confirm
	4) MHz SW: 5 10 kHz SW: 9 SSG OUTPUT: 40 dB	AF V.M					With a signal received, set AF V.M to 0.63V/8Ω. Next, turn the SSG modulation OFF and measure the attenuation by AF V.M.	S/N 40 dB	Confirm
7. SQUELCH	1) SSG OUTPUT: OFF SQV. VR: Critical point	Oscilloscope (or SP)						Critical point 9:00～11:00	Confirm
	2) SSG OUTPUT: −8 dB SQU. VR: Position of item (1)	Oscilloscope (or SP)						When a signal of −8 dB is applied from the SSG. the squelch should open	Confirm

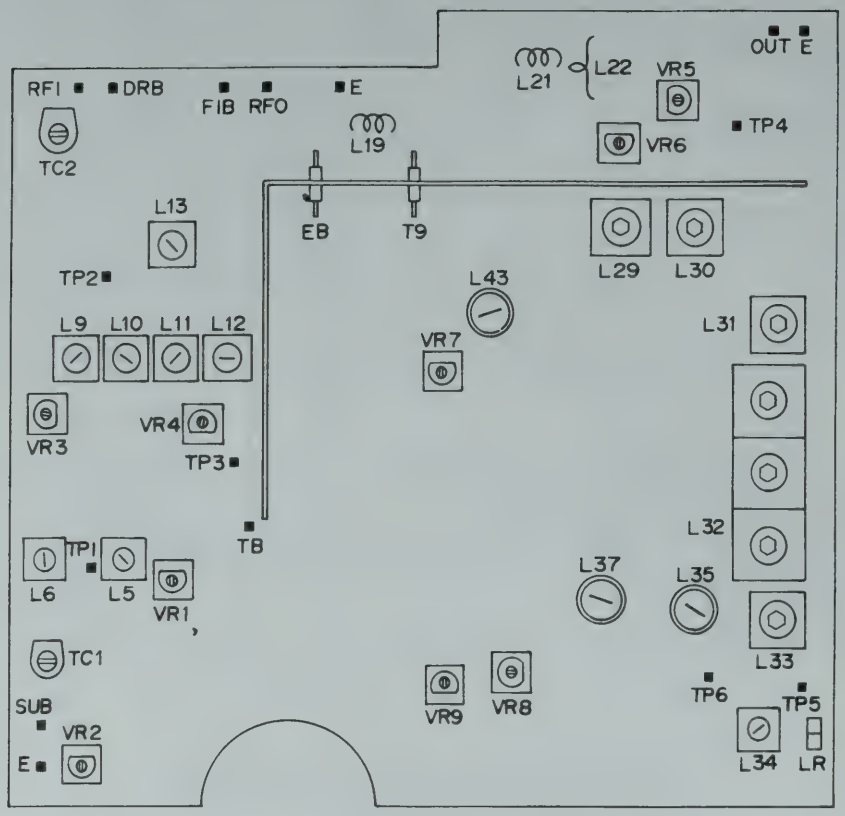
PC BOARD ALIGNMENT

PLL Unit (X50-1380-10)

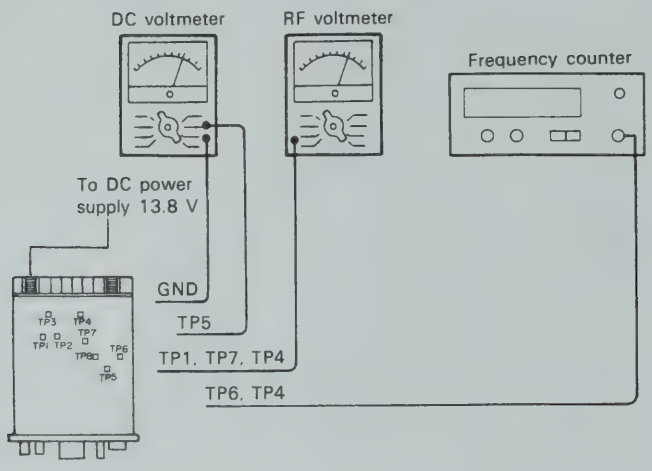


PC BOARD ALIGNMENT

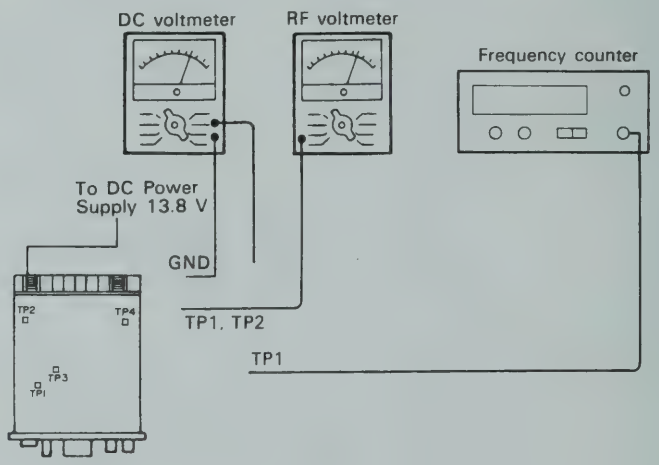
TX, RX Unit (X44-1300-10)



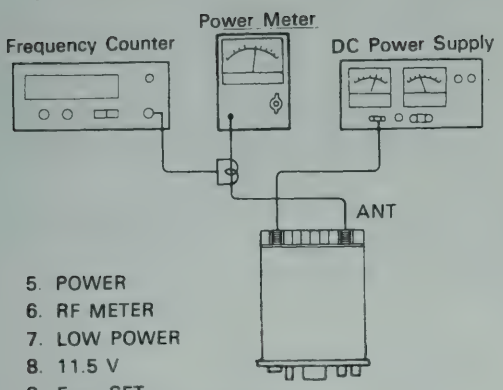
1. Adjustment of PLL Block



2. Tx Section adjustment

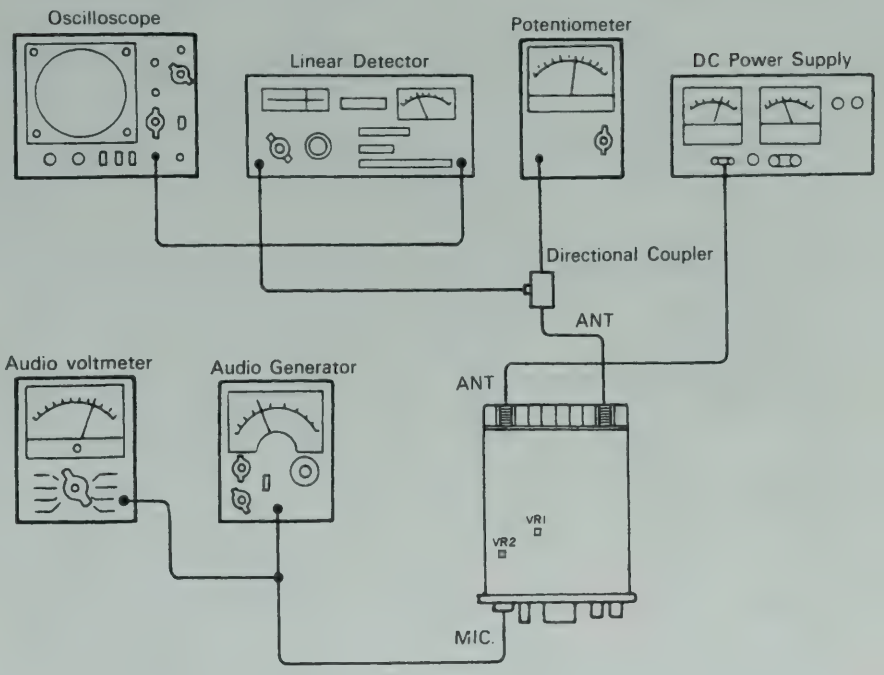


PC BOARD ALIGNMENT

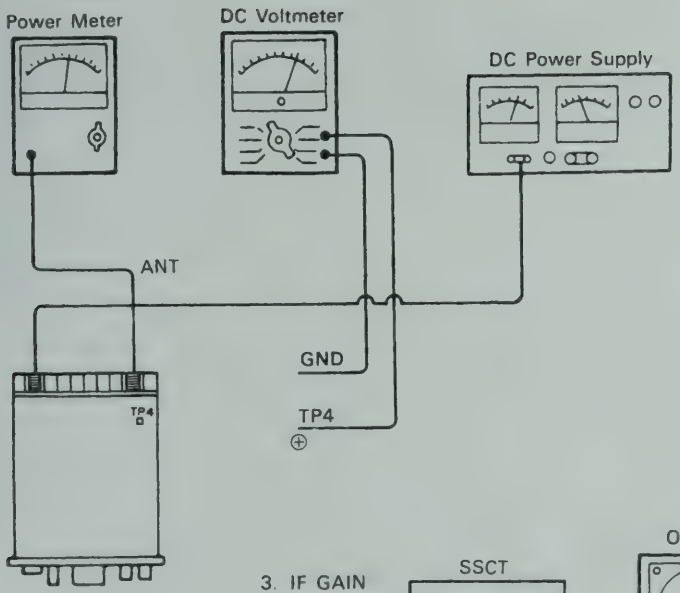


5. POWER
6. RF METER
7. LOW POWER
8. 11.5 V
9. Freq. SET
13. SHIFT AND MEMORY SHIFT

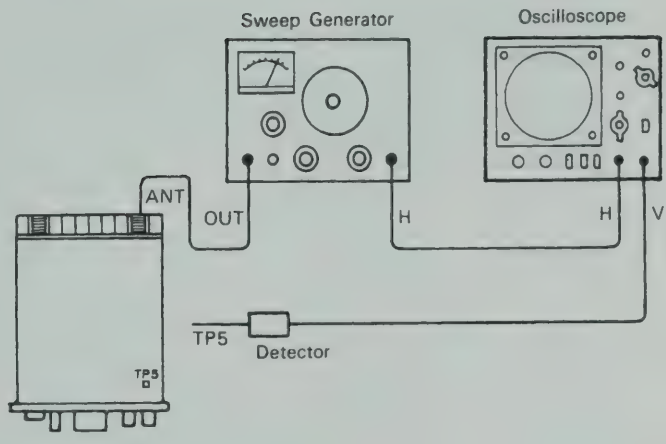
11. DEVIATION
12. ABNORMAL OSCILLATION



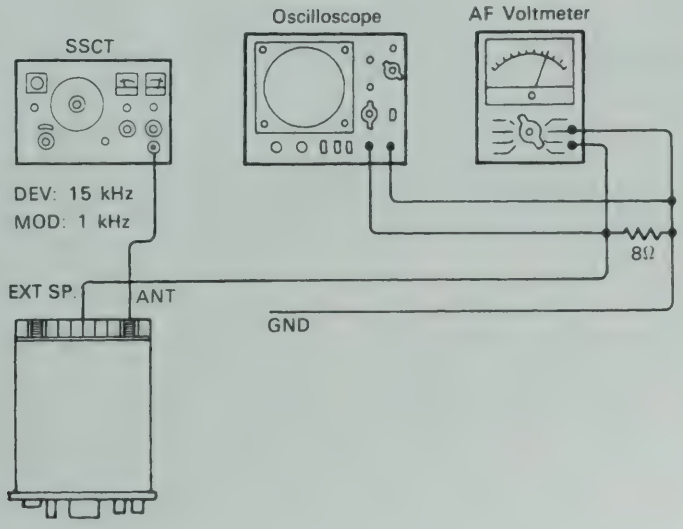
10. Protection



2. Helical



3. IF GAIN
4. S METER
5. Discretion
6. S/N
7. SQUELCH



SPECIFICATIONS

GENERAL

Semiconductors:	Transistors: 53 FETs: 9 ICs: 17 Diodes: 85
Frequency Range:	144.00 to 147.995 MHz
Frequency Synthesizer:	Digital control of phase locked VCO
Synthesizer Stability:	Less than ±750 Hz at 25°C
Mode:	FM
No. of Channels:	800
Operating Temperature:	−20 to +50°C
Power Voltage:	11.5V DC to 16.0V DC (13.8V DC standard)
Grounding:	Negative grounding
Antenna Impedance:	50Ω
DC Current:	Less than 0.5A in receive with no input signal Less than 3A in HI transmit (at 13.8V DC)
Dimensions:	161 mm (6-5/16″) wide 61 mm (2-3/8″) high 230 mm (9-1/16″) deep
Weight:	1.75 kg (3.85 lbs) Approx.

TRANSMITTER SECTION

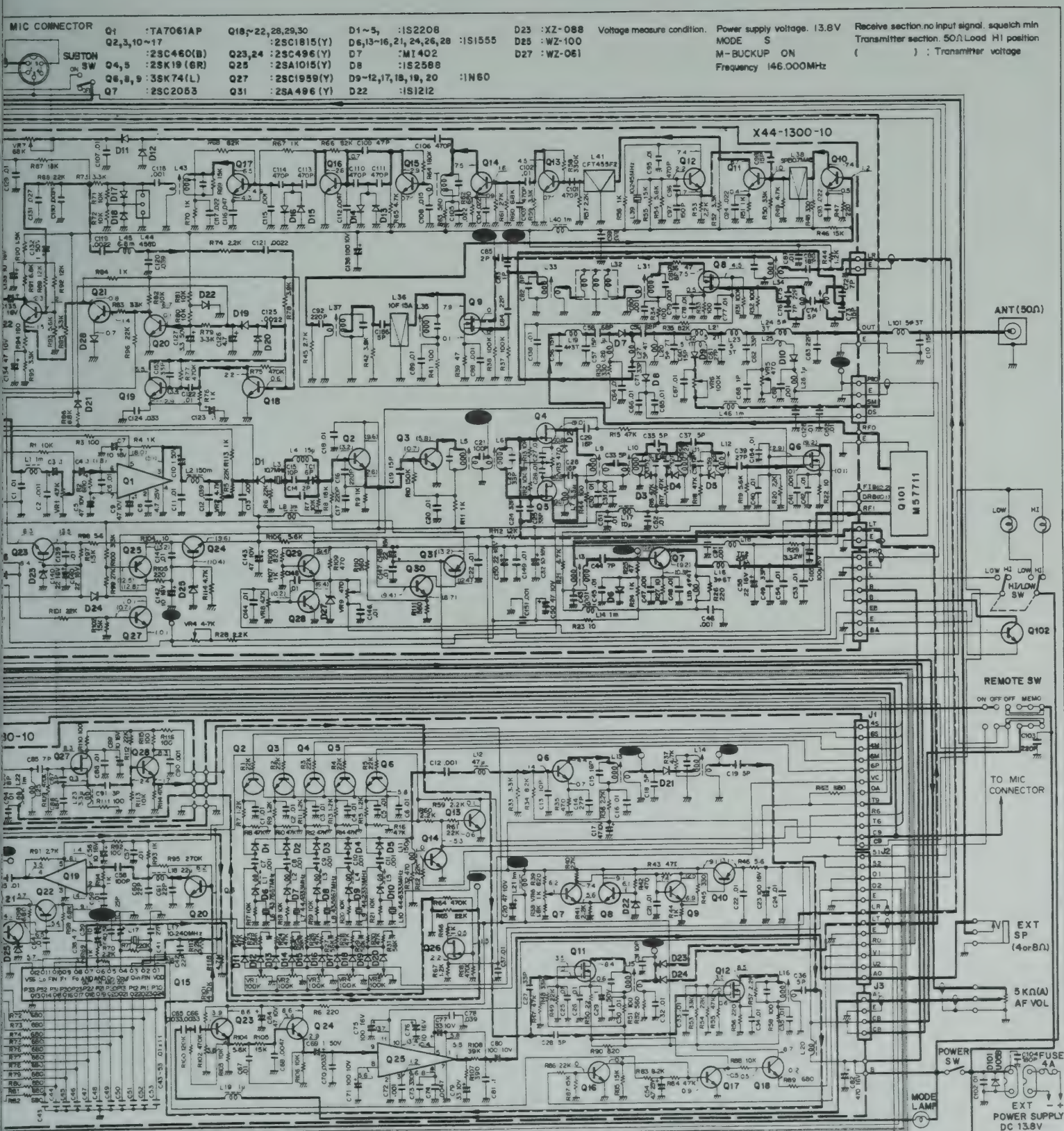
RF Output Power:	High: 10 watts (min.) Low: 1 watts approx. (adjustable to 10 watts)
Modulation:	Variable reactance direct shift
Max. Frequency Deviation:	±5 kHz
Spurious Radiation:	Less than −60 dB
Touch Tone Input Impedance:	600Ω
Microphone:	Dynamic microphone with PTT switch, 500Ω

RECEIVER SECTION

Circuitry:	Double superheterodyne
Intermediate Frequency:	1st: IF 10.7 MHz 2nd: IF 455 kHz
Sensitivity:	Less than 0.4 μV for 20 dB quieting (Less than 1 μV for 30 dB S/N)
Squelch Sensitivity:	Less than 0.25 μV
Pass Band Width:	More than 12 kHz at 6 dB down
Selectivity (2 Signal):	More than 76 dB at 30 kHz of adjacent channel
Image Rejection:	More than 70 dB
Spurious Interference:	More than 60 dB
Intermodulation:	More than 66 dB
Audio Output:	More than 1.5 watts across 8Ω load (10% distortion)

NOTE: The circuit and ratings may change without notice due to developments in technology.

TIC DIAGRAM



1~3,4,5,7,8,13,14,16,18,21,22	Q11,12	:3SK74(L)	Q23,24	:2SC2240(GR)	D1~5	:1S2588	D23~24	:1S2588
: 2SC1815(Y)	Q15	:SM5111A	Q25	:AN315	D6~10	:1SV53A	D25	:WZ-040
: 2SC460(B)	Q17	:2SC1345(E)	Q26	:2SK30A(GR)	D11~20	:1S1555	D26	:1S2208
: 2SC1959(Y)	Q19	:TA7060P	Q27	:2SK19(GR)	D21	:1SS16		
: 2SA496(Y)	Q20,28	:2SC1923(O)			D22	:XZ-060		

TR-7600(K)

SPECIFICATIONS

GENERAL

Semiconductors:	Transistors: 53 FETs: 9 ICs: 17 Diodes: 85
Frequency Range:	144.00 to 147.995 MHz
Frequency Synthesizer:	Digital control of phase locked VCO
Synthesizer Stability:	Less than ±750 Hz at 25°C
Mode:	FM
No. of Channels:	800
Operating Temperature:	−20 to +50°C
Power Voltage:	11.5V DC to 16.0V DC (13.8V DC standard)
Grounding:	Negative grounding
Antenna Impedance:	50Ω
DC Current:	Less than 0.5A in receive with no input signal Less than 3A in HI transmit (at 13.8V DC)
Dimensions:	161 mm (6-5/16") wide 61 mm (2-3/8") high 230 mm (9-1/16") deep
Weight:	1.75 kg (3.85 lbs) Approx.

TRANSMITTER SECTION

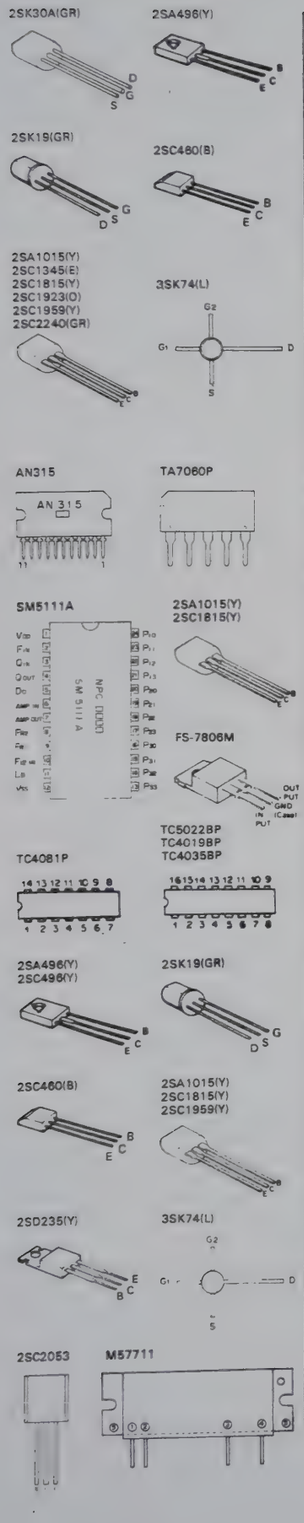
RF Output Power:	High: 10 watts (min.) Low: 1 watts approx. (adjustable to 10 watts)
Modulation:	Variable reactance direct shift
Max. Frequency Deviation:	±5 kHz
Spurious Radiation:	Less than −60 dB
Touch Tone Input Impedance:	600Ω
Microphone:	Dynamic microphone with PTT switch, 500Ω

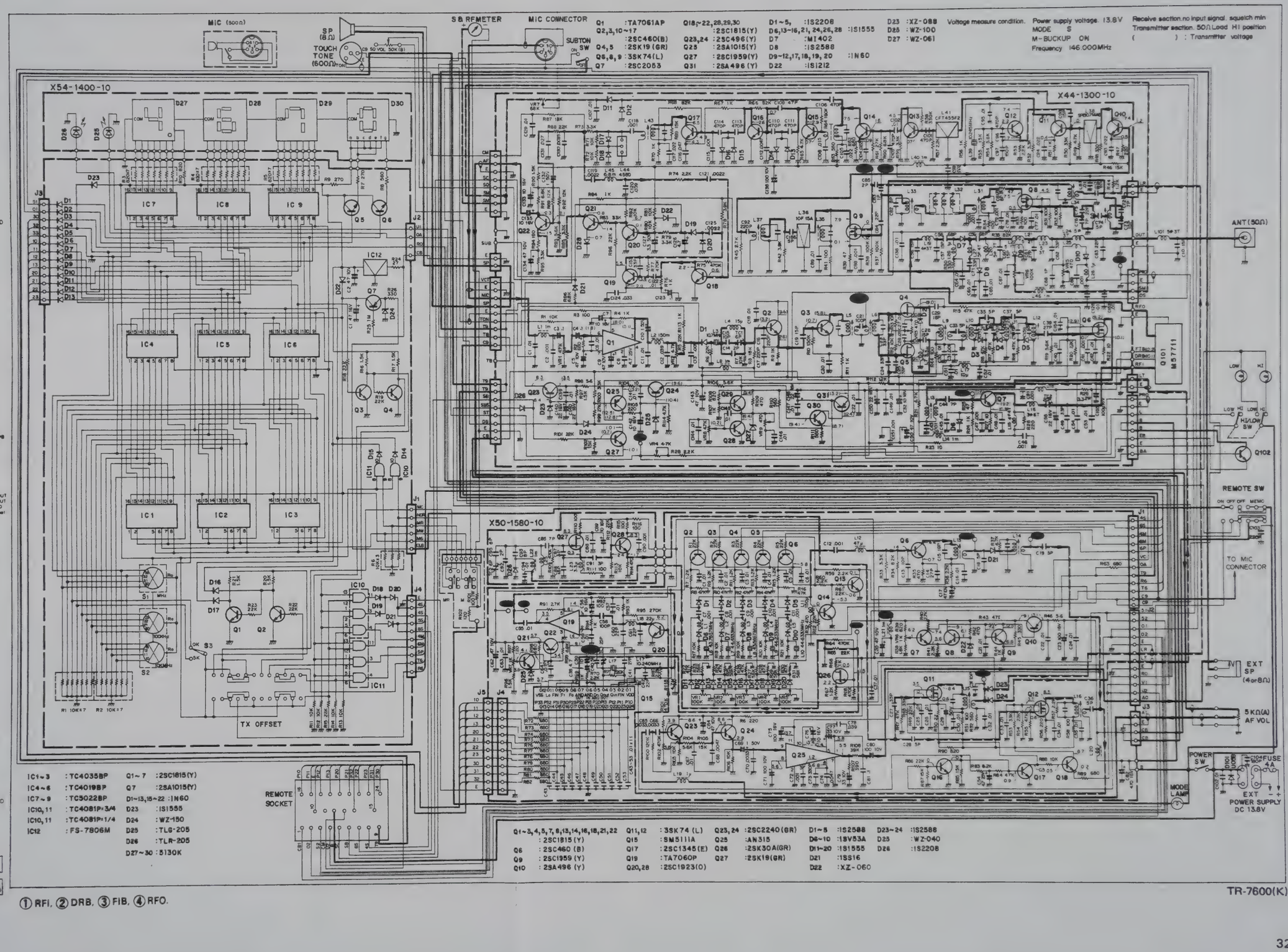
RECEIVER SECTION

Circuitry:	Double superheterodyne
Intermediate Frequency:	1st: IF 10.7 MHz 2nd: IF 455 kHz
Sensitivity:	Less than 0.4 μV for 20 dB quieting (Less than 1 μV for 30 dB S/N)
Squelch Sensitivity:	Less than 0.25 μV
Pass Band Width:	More than 12 kHz at 6 dB down
Selectivity (2 Signal):	More than 76 dB at 30 kHz of adjacent channel
Image Rejection:	More than 70 dB
Spurious Interference:	More than 60 dB
Intermodulation:	More than 66 dB
Audio Output:	More than 1.5 watts across 8Ω load (10% distortion)

NOTE: The circuit and ratings may change without notice due to developments in technology.

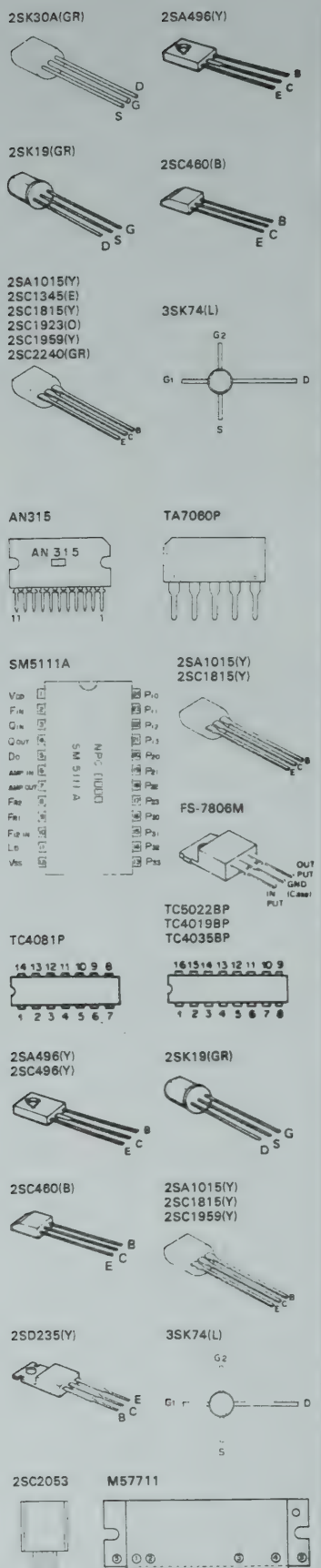
SCHEMATIC DIAGRAM

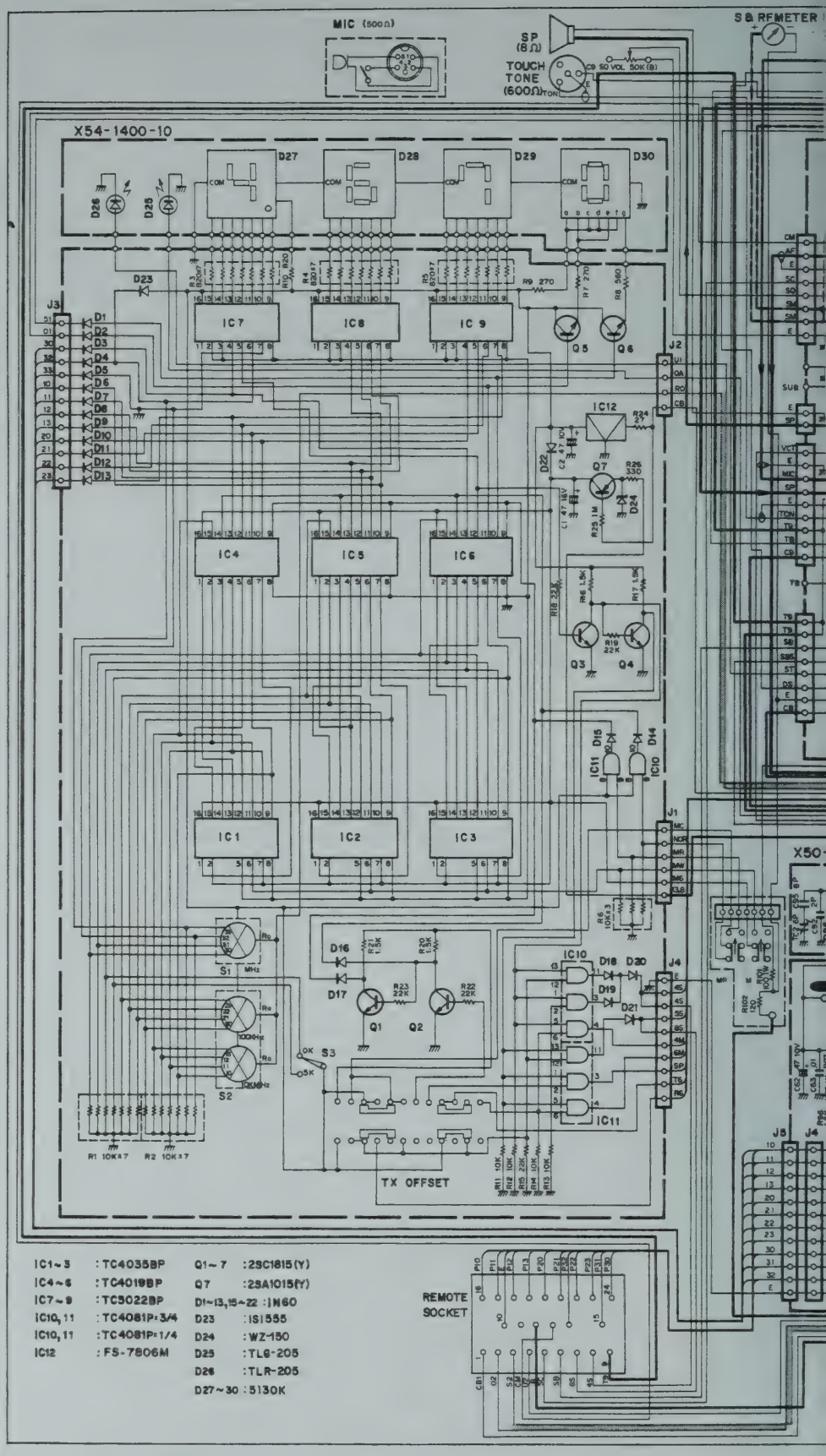




① RFI, ② DRB, ③ FIB, ④ RFO.

TR-7600(K)

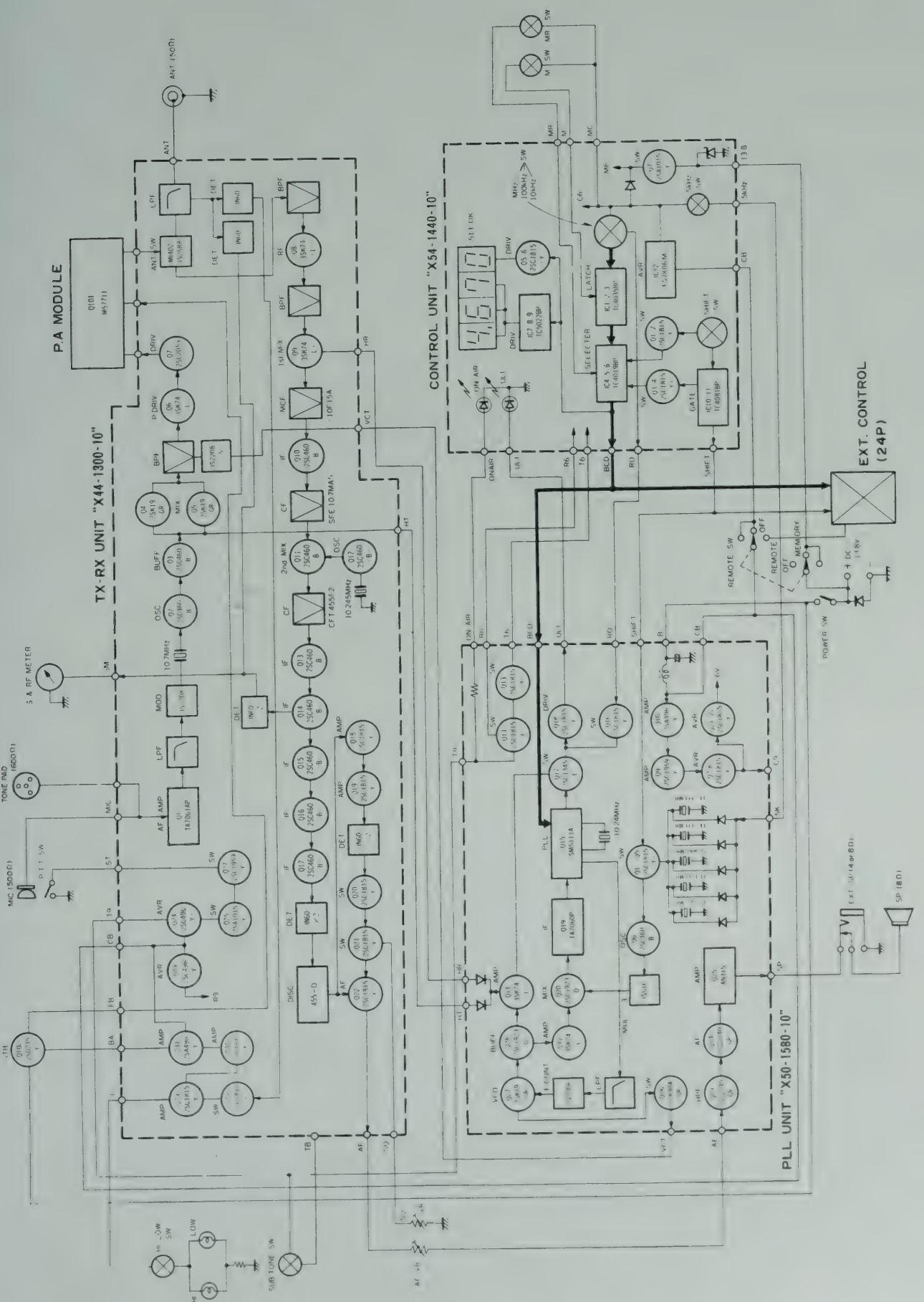




IC1~3	: TC4035BP	Q1~7	: 2SC1815(Y)
IC4~6	: TC4019BP	Q7	: 2SA1015(Y)
IC7~9	: TC5022BP	D1~13,15~22	: 1N60
IC10,11	: TC4081P×3/4	D23	: 1S1555
IC10,11	: TC4081P×1/4	D24	: WZ-150
IC12	: FS-7806M	D25	: TLG-205
		D26	: TLR-205
		D27~30	: 5130K

① RFI, ② DRB, ③ FIB, ④ RFO.

BLOCK DIAGRAM



A product of
TRIO-KENWOOD CORPORATION
6-17, 3-chome, Aobadai, Meguro-ku, Tokyo 153, Japan

TRIO-KENWOOD COMMUNICATIONS, INC.
1111 West Walnut Street Compton California 90220 U.S.A.
TRIO-KENWOOD COMMUNICATIONS, GmbH
D-6374 Steinbach TS Industriestrasse 8A West Germany
TRIO-KENWOOD(AUSTRALIA)PTY. LTD.
30 Whiting Street Artarmon Sydney N.S.W. Australia 2064

1978-12 PRINTED IN JAPAN B51-0865-00 1000 (K)(W)(T) (G)

KENWOOD

SERVICE MANUAL

TR-7600

2m FM TRANSCEIVER

INDUCTION/CONTENTS

INTRODUCTION

Your KENWOOD Model TR-7600 is an advanced 2-meter transceiver for amateur mobile, and optional fixed station operation.

The TR-7600 features:

- ☆ Memory channel (simplex and repeater mode).
- ☆ Memory TX and ±600 kHz repeater TX for repeater operation.
- ☆ 800 channel PLL circuit.
- ☆ Digital frequency display.
- ☆ Dual concentic frequency selector switches.
- ☆ PLL UNLOCK and ON AIR indicators.
- ☆ Subaudible ON/OFF switch (Encoder user installed)
- ☆ Powered tone pad connector with 9V DC on one pin.
- ☆ Pin Mic connector with 9V DC on one pin.
- ☆ TX HI-LOW (Power) switch

CONTENTS

GENERAL/CIRCUIT DESCRIPTION

GENERAL

The TR-7600 is a 10W, multi-channel (800 channels) FM transceiver covering 144 ~ 147.995 MHz. It features a built-in repeater shift circuit and memory circuit, and provision for connection of an option remote controller for operation with a micro-computer.

PLL CIRCUIT

The TR-7600 employs PLL circuit composed of IC SM5111A for programmable counter, reference oscillator, frequency divider and phase detector. Setting of frequency division ratio, frequency memory and remote indication functions are all controlled by BCD codes

PLL CIRCUIT BLOCK DIAGRAM

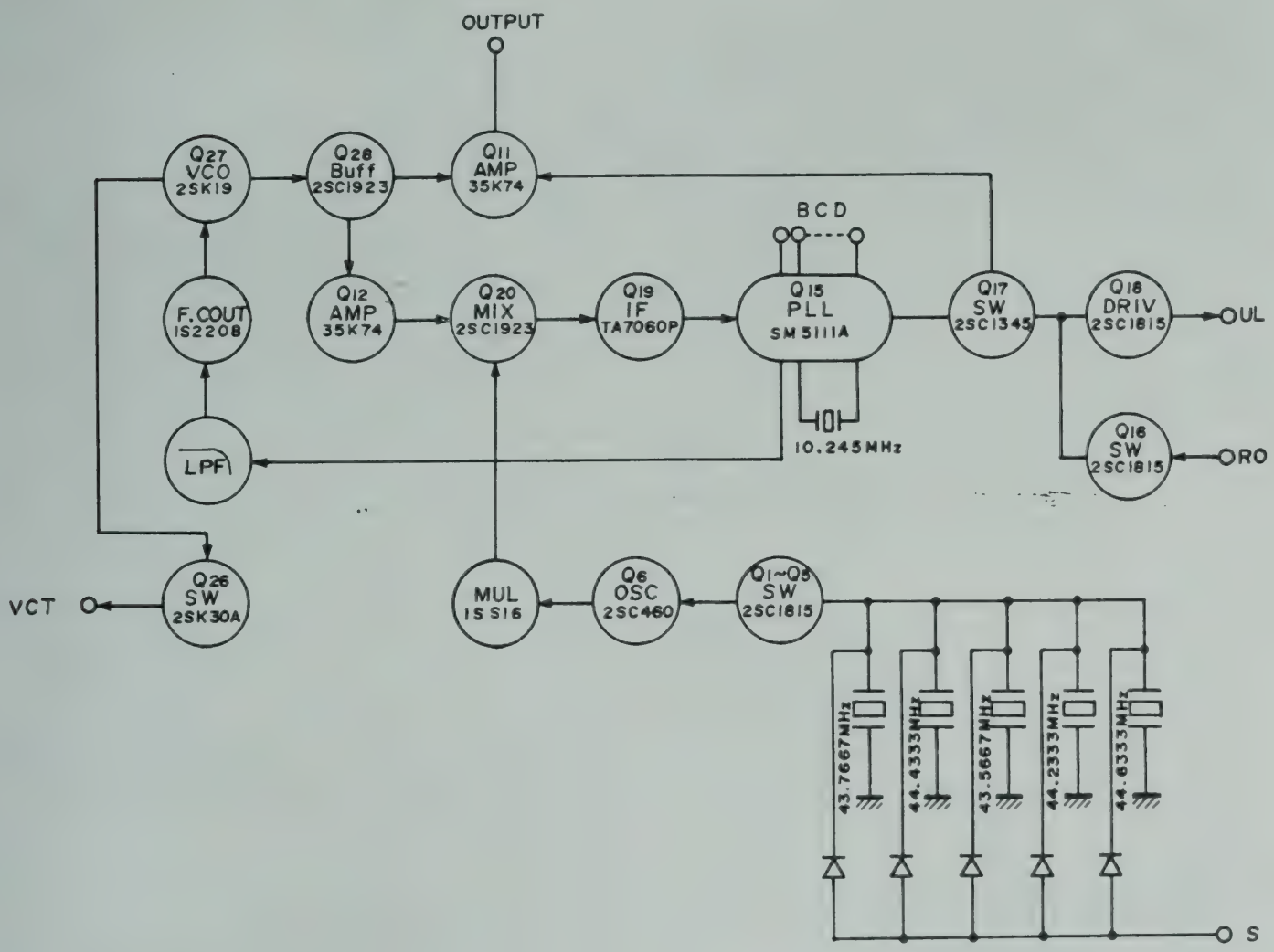


Fig. 1 PLL Circuit

CIRCUIT DESCRIPTION

1. Phase Locked Loop

The 130 MHz signal from Q27 passes through the buffer circuit Q28 and is then divided into a synthesizer output and a loop output by Q11 and Q12 respectively. The output from Q12 is mixed with the local oscillator output, trippled by Q6 and 1SS16, by Q20 to obtain IF frequency. The IF output is amplified by Q19 and is fed to Q15 where the output is frequency divided in the ratio specified by BCD code to compare it with the 10 kHz reference frequency (1/1024 of 10.240 MHz).

The DC output thus obtained passes through the low-pass filter to control the VCO vari-cap 1S2208. The output from Q26 controls the transmit frequency bandwidth. When the signal is unlocked, the output is shut off by Q17 which is indicated by Q18. Q16 is used to shut off the output when the rotary switch is between channel setting positions.

Rx Tx Freq.	Simplex Output	Division	Osc Xtal Freq.	IF Freq.
144.00 MHz	133.3 MHz	200	43.7667 MHz	2 MHz
145.00 MHz	134.3 MHz	300	43.7667 MHz	3 MHz
145.99 MHz	135.29 MHz	399	43.7667 MHz	3.99 MHz
146.00 MHz	135.3 MHz	200	44.4333 MHz	2 MHz
147.00 MHz	136.3 MHz	300	44.4333 MHz	3 MHz
147.99 MHz	137.29 MHz	399	44.4333 MHz	3.99 MHz

Table 1 Division and Frequency

2. +5 kHz Circuit

In the PLL circuit, the reference frequency is controlled in 10 kHz steps. The +5 kHz signal is controlled by varying the local oscillator crystal frequency with the vari-cap, so the frequency division remains unchanged even when the +5 kHz circuit is operated.

The memory circuit also includes the same bit and functions even when the +5 kHz circuit is operating.

3. Shift Circuit

Transmit frequencies can be shifted by changing the local oscillator crystal, as shown below.

144 and 145 MHz bands:

[−] shift	43.5667 MHz
[S]	43.7667 MHz

The [+] shift is not available for 144 and 145 MHz bands.

The [S] is obtained at the [+] position.

146 and 147 MHz Bands:

[−] shift	44.2333 MHz
[+] shift	44.6333 MHz
[S]	44.4333 MHz

4. Memory Shift Circuit

The memory shift circuit (MT) is a circuit to shift the memory input frequency during transmission. The function is the same as in [S].

CONTROL UNIT

Frequency settings are accomplished by the MHz, 100 kHz and 10 kHz rotary switches. The relationship between the frequency and frequency division is shown below.

Frequency	Frequency division
144.000 MHz	200
145.000 MHz	300
145.990 MHz	399
146.000 MHz	200
147.000 MHz	300
147.990 MHz	399

The local oscillator frequency of kHz order can be shifted by the switch. The frequency division set by the rotary switch is stored in the latch IC's 1, 2 and 3 by pressing the memory input switch. The output from the latch circuit is fed through IC's 4, 5 and 6 in the selector circuit to the PLL circuit by pressing the memory call switch. When this switch is not pressed, the output is directly fed to the PLL circuit. Memory function is effected by latching each switch. The information from each switch is stored by pressing the memory switch. The stored information remains the same unless the memory switch is pressed once again. Selection of memory output and rotary output is accomplished by the selector circuit. A latched output is obtained by pressing the memory output switch.

The signal to the PLL circuit passes through the LED driver circuit and is digitally indicated by LED (orange).

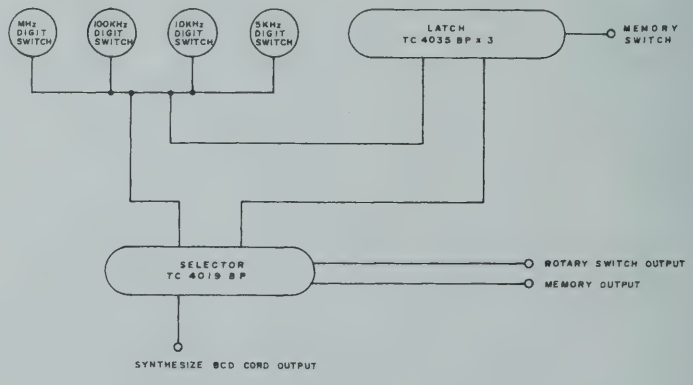


Fig. 2 Block Diagram of Frequency Memory Circuit

CIRCUIT DESCRIPTION

TRANSMITTER UNIT

The microphone signal passes through the limiter amplifier and is FM modulated by the 10.7 MHz oscillator. The signal is mixed with the local oscillator signal to obtain 144 ~ 146 MHz signal. The B.P.F. is of a variable type, providing excellent characteristics with respect to power and spurious even at the shift time because of the use of VCO voltage. The power stage uses the power module M5711 manufactured by the Mitsubishi Electric Co., to provide higher reliability.

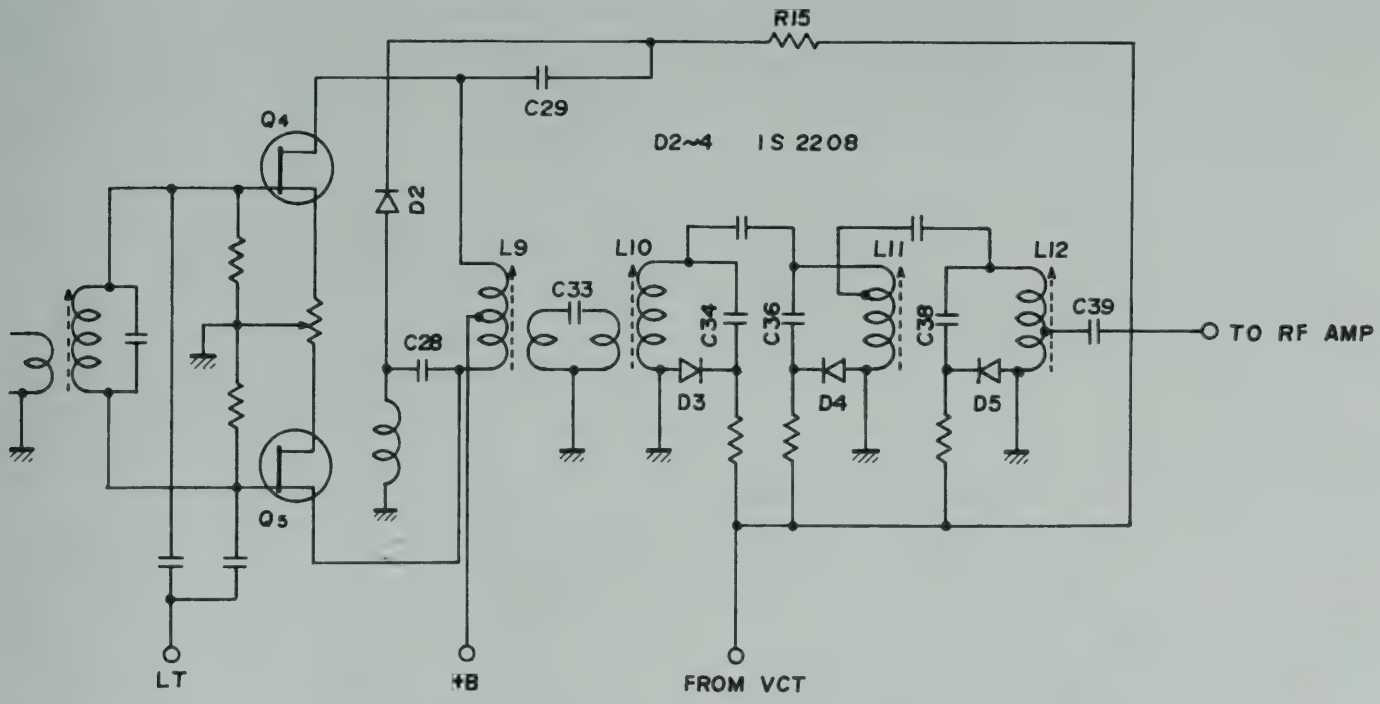


Fig. 3 Variable Band Width Control Circuit (for Transmission)

RECEIVER UNIT

The signal from the transmit/receive matching circuit passes through the diode switch and is fed to the 2-stage antenna tuning circuit, 3-stage merical tuning circuit and RF amplifier of MOS FET. This signal is further fed to the mixer circuit MOS FET where it is converted into 10.7 MHz signal. The signal thus converted passes through the 2-stage filter and is fed to the 2nd mixer where it is converted into 455 kHz signal. The 2nd IF signal from the 455 kHz ceramic filter passes through the limiter circuit where it is converted into AF signal by the ceramic discriminator. This signal is amplified by the audio power amplifier to drive the speaker.

The receiver unit includes a noise amplification type squelch circuit. This circuit picks up the noise component in the squelch signal from the discriminator which is amplified and rectified to control the 1st stage AF amplifier.

The characteristic of the discriminator is opposite that of conventional ones to permit connection of a remote controller

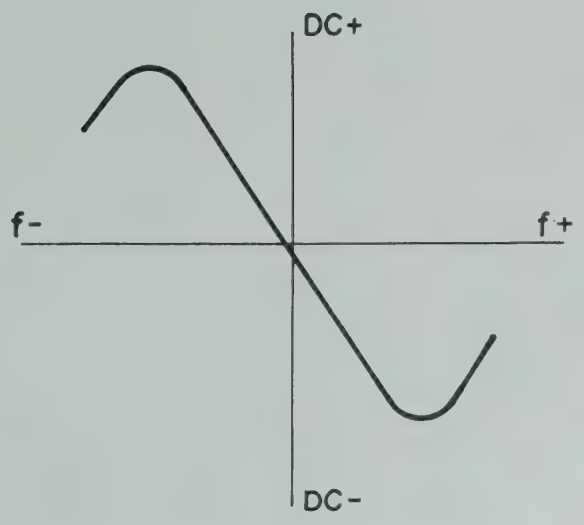


Fig. 4 Discriminator Characteristics

SM5111A

Electrostatic Breakdown Protection

This product has a built-in input protection circuit to prevent a gate breakdown due to static electricity.

In order to protect the input circuit from damage due to a large static electricity or voltage in excess of the limit permissible to the circuit, the following points should be observed:

1. When the product is not in use, keep all the terminals in contact with insulating material (this is done at the factory prior to shipment).
2. Soldering iron, testing instrument and other tools should be earthed while in use.
3. Do not insert or remove IC from the socket without turning off the power
4. Do not apply signal voltage to the input terminal when the power is OFF.
5. Do not apply a voltage exceeding the power voltage to the input terminal.

OPERATING SYSTEM

This product has been developed as C-MOS LSI used for PLL circuit. As shown in the block diagram in Fig. 1, it consists of OSC: reference oscillator circuit, DIVIDER: reference frequency dividing circuit, PC: programmable counter, PD: phase comparator, and INV: inverter. A high accuracy feedback type crystal oscillator circuit can be formed by adding a crystal oscillating element, resistor and capacitor between the QIN and QOUT terminals of the reference oscillator circuit. This also permits an external signal to be fed to the QIN terminal.

The oscillator output is applied to the reference frequency dividing circuit where it is divided into the desired frequencies of fr1 (1/2028) and fr2 (1/1024) which are the reference signals of the digital type phase comparator on the next stage

The comparison signal (frequency f1) fed to the input terminal FIN of the AMP is amplified and wave shaped, then fed to the input of the programmable counter. The frequency "f1" is frequency converted (fpc) through the program terminals P01 ... P33 (for example, when P01 ... P33 = 1, the programmable counter output is 1/999), and is fed to the phase comparator where the reference signal is compared with the comparison signal in phase so that a pulse signal, shown below, proportional to the phase difference in two signals is fed to the output terminal DO

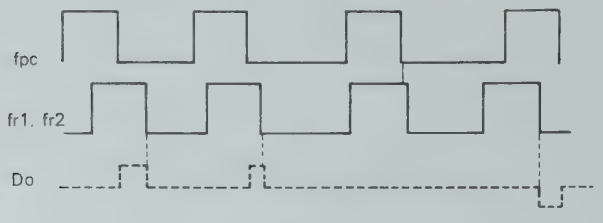


Fig. 5

The table below shows the maximum limits of operating conditions and environmental conditions. If any of these values exceeds the given limits, it can be a cause of damage to the product or deterioration of quality.

Item	Symbol	Rating	Unit
Power Supply Voltage	$V_{DD} - V_{SS}$	$-0.3 \sim +7.5$	V
Input Voltage	V_{IN}	$V_{SS} \leqq V_{IN} \leqq V_{DD}$	V
Operating Temperature	T_A	$-30 \sim +70$	°C
Storage Temperature	T_{STG}	$-40 \sim +125$	°C
Power Consumption	P_D	250	mW
Soldering Temperature		260	°C
Soldering Time		5	sec

Table 2 SM5111A Absolute Maximum Ratings

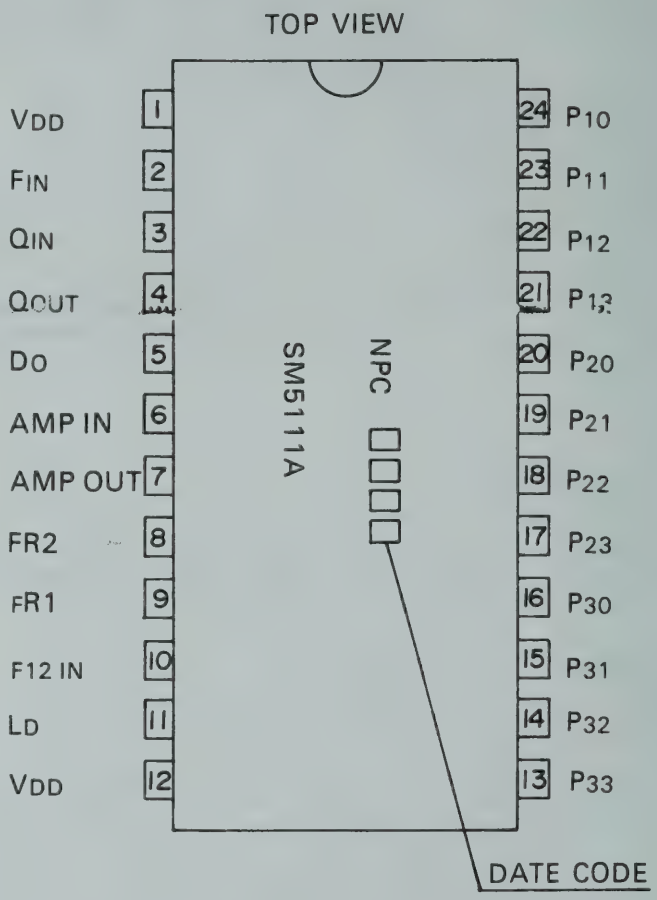


Fig. 6 SM5111A Pin Arrangement

DATA

3SK74

SPECIFICATIONS

Application	VHF RF Amplifier (Mixer)	
Construction	N-Channel • MOS FET (Dual Gate)	
Drain • Source Voltage	V_{DSX}	20V
Gate 1 • Source Voltage	V_{G1S}	±10V
Gate 2 • Source Voltage	V_{G2S}	±10V
Drain Current	I_D	25 mA
Allowable Loss	P_T	200 mW
Channel Temperature	T_{CH}	125°C
Storage Temperature	T_{STG}	−5.5 ~ +125°C

Maximum Specifications

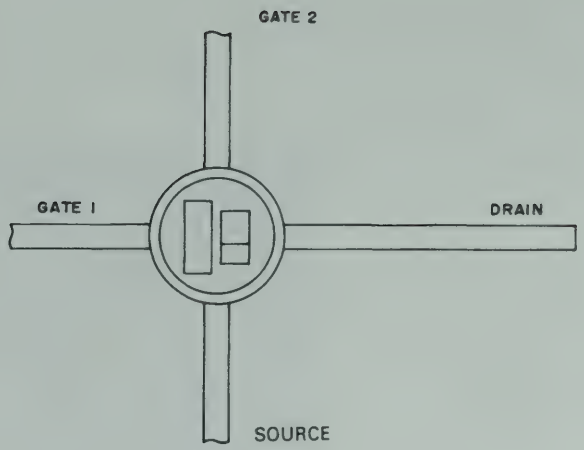


Fig. 7 3SK74 Outlines

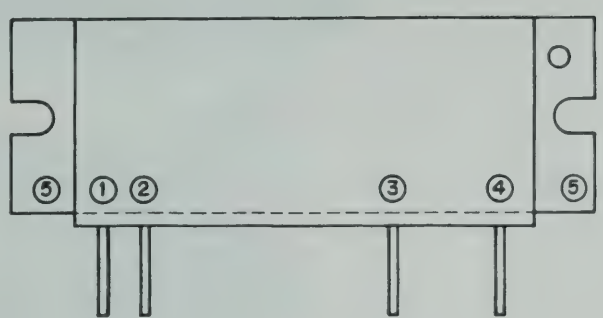
TEST CONDITION

Item	Code	Condition
Drain • Source Voltage	V_{DSX}	V_{G1S} = −3V, V_{G2S} = 3V, I_D = 500nA
Drain Current	I_{DSS}	V_{DS} = 6V, V_{G1S} = 0, V_{G2S} = 3V
Cut-Off Voltage (Gate 1)	V_{G1S}	V_{DS} = 6V, V_{G2S} = 0, I_D = 500nA
Cut-Off Voltage (Gate 2)	V_{G2S}	V_{DS} = 6V, V_{G1S} = 0, I_D = 500nA
Gate Leak Current (Gate 1)	I_{G1SS}	V_{DS} = 0, V_{G1S} = ±10V, V_{G2S} = 0
Gate Leak Current (Gate 2)	I_{G2SS}	V_{DS} = 0, V_{G1S} = 0, V_{G2S} = ±10V
Small Signal Transfer Admittance	$\lvert y_{fs} \rvert$	V_{DS} = 6V, V_{G2S} = 3V, I_D = 10mA, f = 1.0 kHz
Small Signal Input Capacity	C_{ISS}	V_{DS} = 6V, V_{G2S} = 3V, I_D = 10mA, f = 1.0 MHz
Small Signal Output Capacity	C_{OSS}	V_{DS} = 6V, V_{G2S} = 3V, I_D = 10mA, f = 1.0 MHz
Small Signal Feedback Capacity	C_{RSS}	V_{DS} = 6V, V_{G2S} = 3V, I_D = 10mA, f = 1.0 MHz
Output Power Gain	G_P	V_{DD} = 10V, I_D = 10mA, f = 200 MHz
Noise Figure	NF	V_{DD} = 10V, I_D = 10mA, f = 200 MHz

Maximum Rating of M57711

(TA = 25°C, unless otherwise noted)

Item	Symbol	Condition	Value	Unit
Operating Voltage	V_{CC}		17	V
DC Current	I_{CC}		5	A
Operating Temperature	$T_{C(OP)}$		−30 ~ +110	°C
Storage	T_{STG}		−30 ~ +110	°C



1. Input Terminal (RFI)
2. Power Supply of Drive Stage (DRB)
3. Power Supply of Output Stage (FIB)
4. Output Terminal (RFO)
5. GND

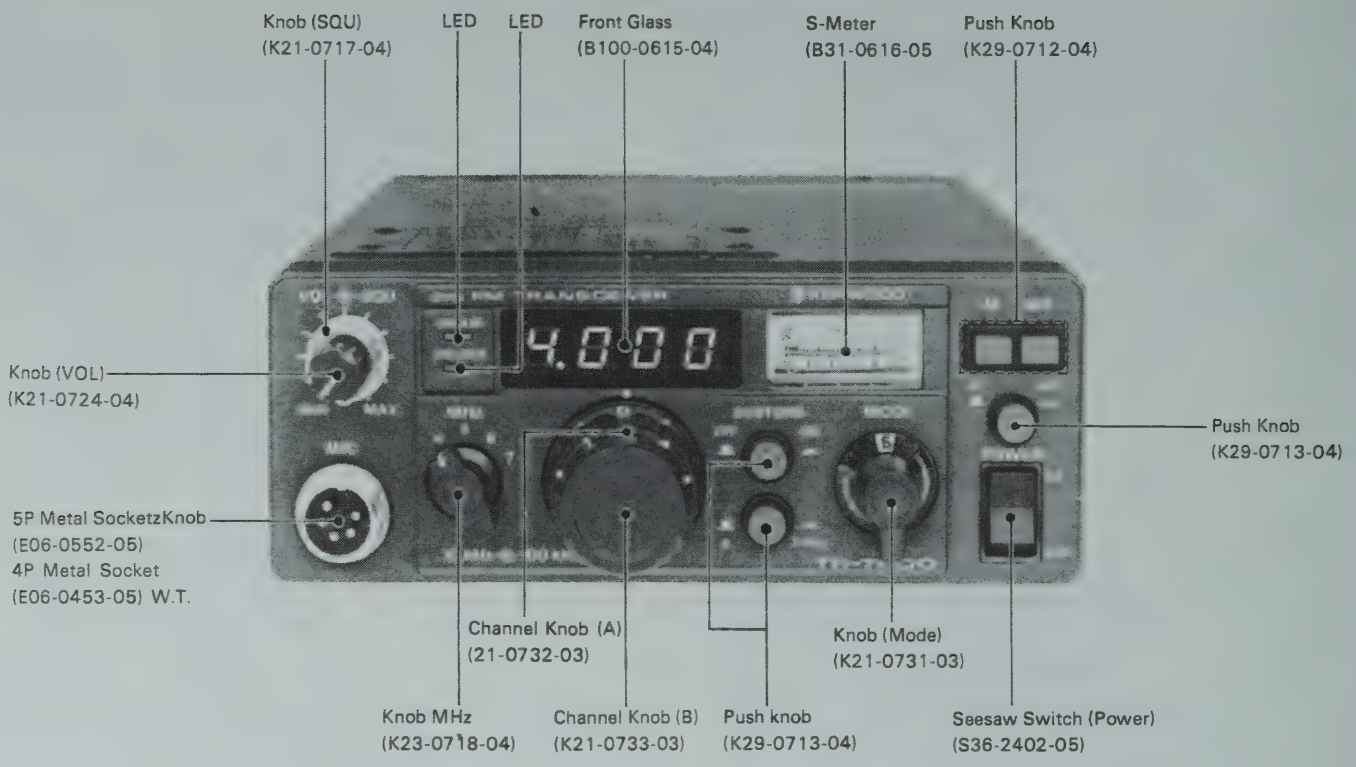
Fig. 8 M57711 Outlines

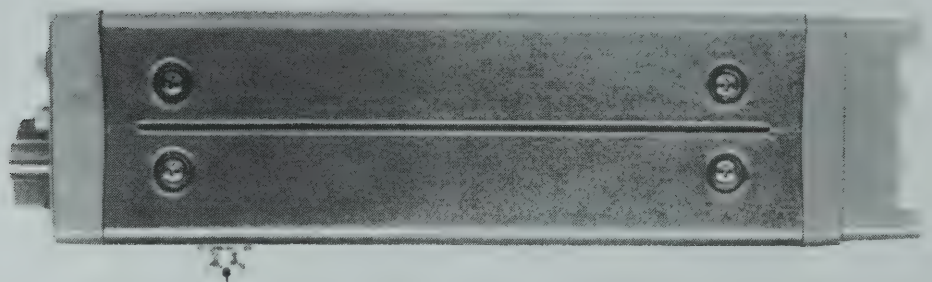
Electrical Characteristic of M57711

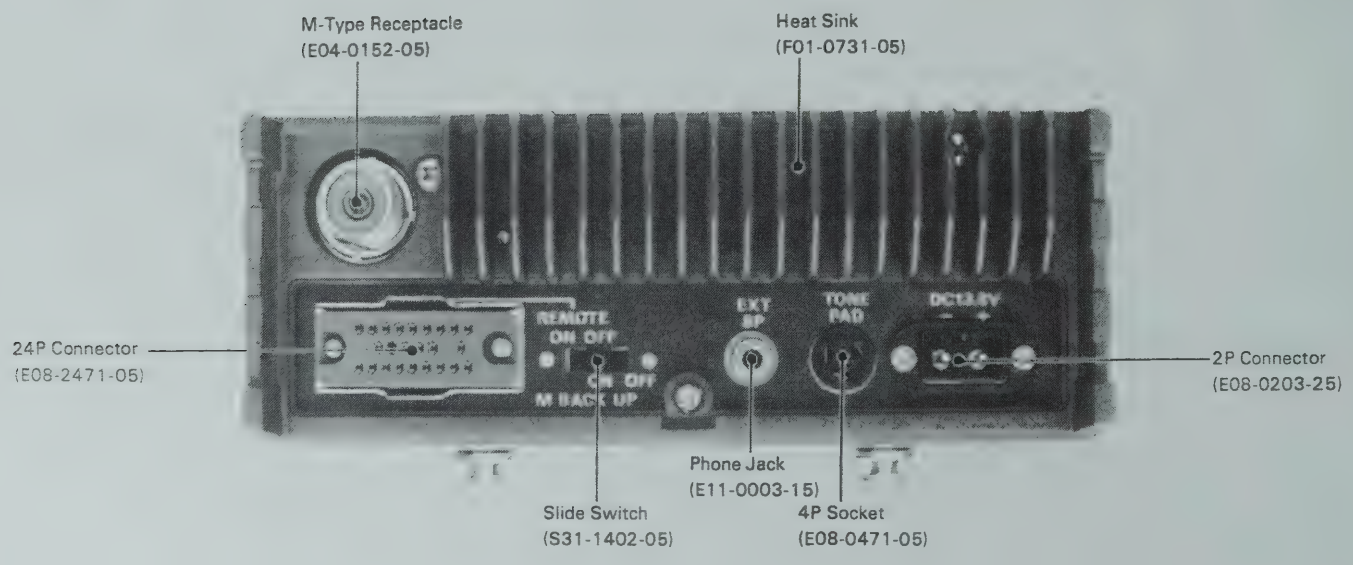
(TA = 25°C unless otherwise noted)

Item	Symbol	Condition	Value			Unit
			Min.	Std.	Max.	
Output Power	P_O	f = 144 ~ 148 MHz, V_{CC} = 12V, Pin = 0.15W, Z_G = Z_L = 50Ω	14	16		W
Total Efficiency	S_T	f = 144 ~ 148 MHz, V_{CC} = 12V, Pin = 0.15W, Z_G = Z_L = 50Ω	53	58		%
2nd Harmonic Radiation		f = 144 ~ 148 MHz, V_{CC} = 12V, Pin = 0.15W, Z_G = Z_L = 50Ω			−25	dB
More than 3rd Harmonic Radiation		f = 144 ~ 148 MHz, V_{CC} = 12V, Pin = 0.15W, Z_G = Z_L = 50Ω			−35	dB
Input VSWR	P_{IN}	f = 144 ~ 148 MHz, V_{CC} = 12V, Pin = 0.15W, Z_G = Z_L = 50Ω		2.5	2.8	
Output VSWR	P_{OUT}	f = 144 ~ 148 MHz, V_{CC} = 12V, Pin = 0.15W, Z_G = Z_L = 50Ω		1.3	1.5	
Impedance		Note	∞ : 1			

PANEL CONTROLS

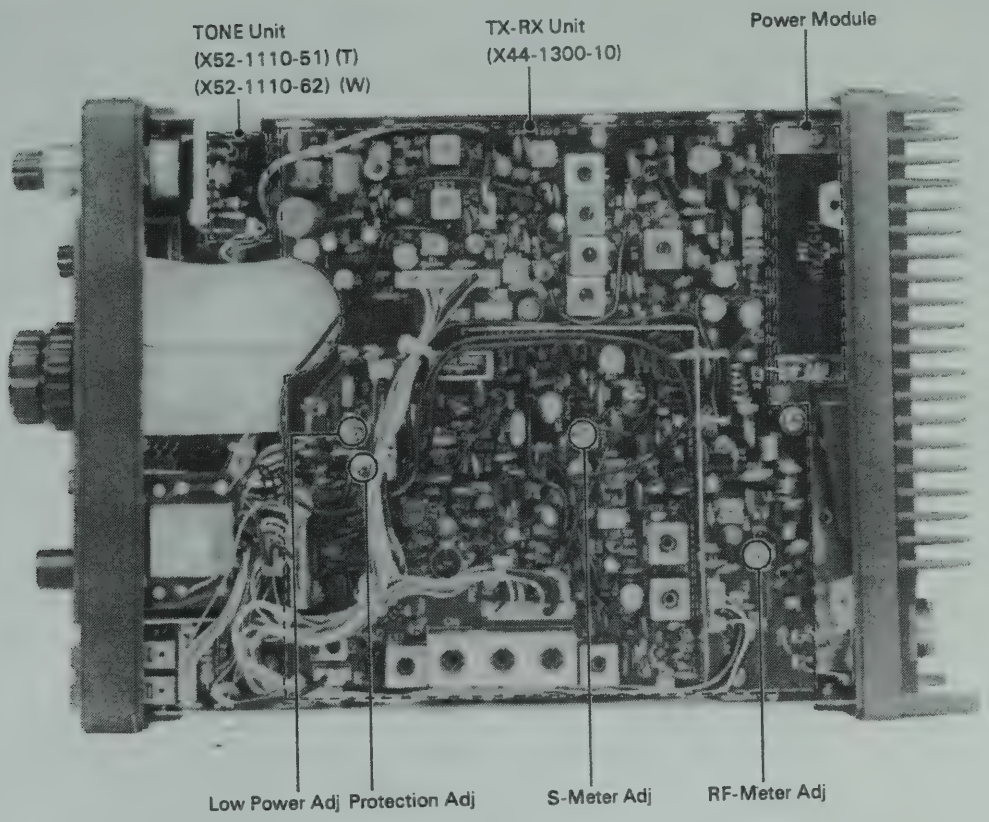




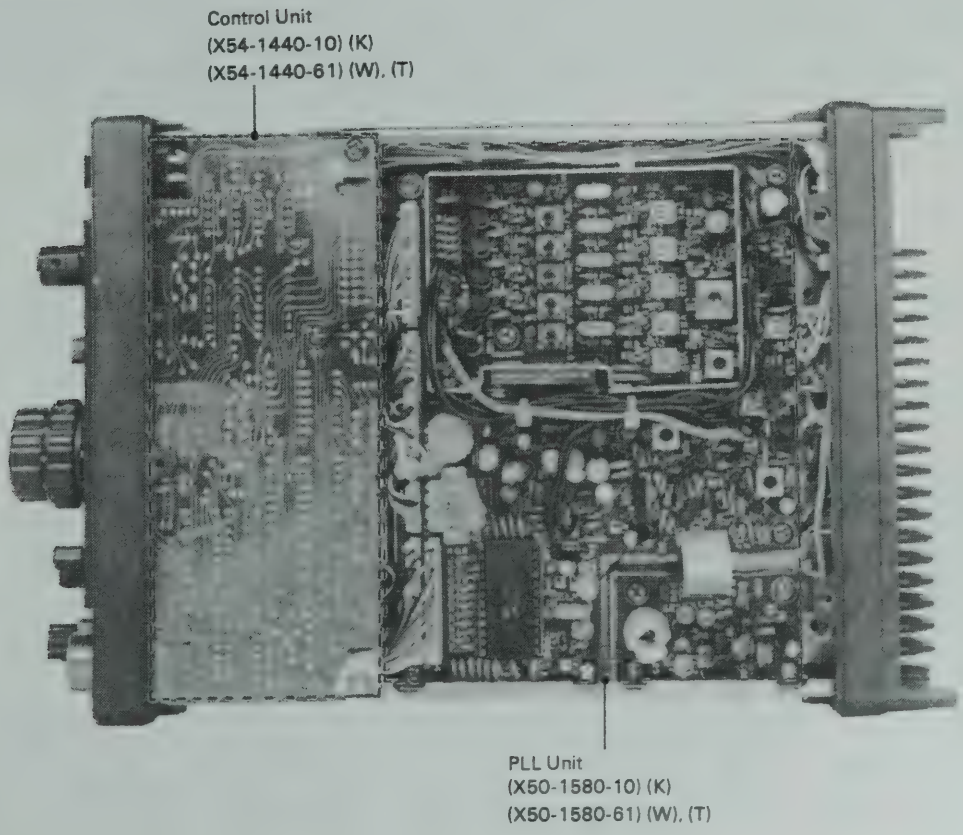


PARTS ALIGNMENT

VIEWED FROM TOP

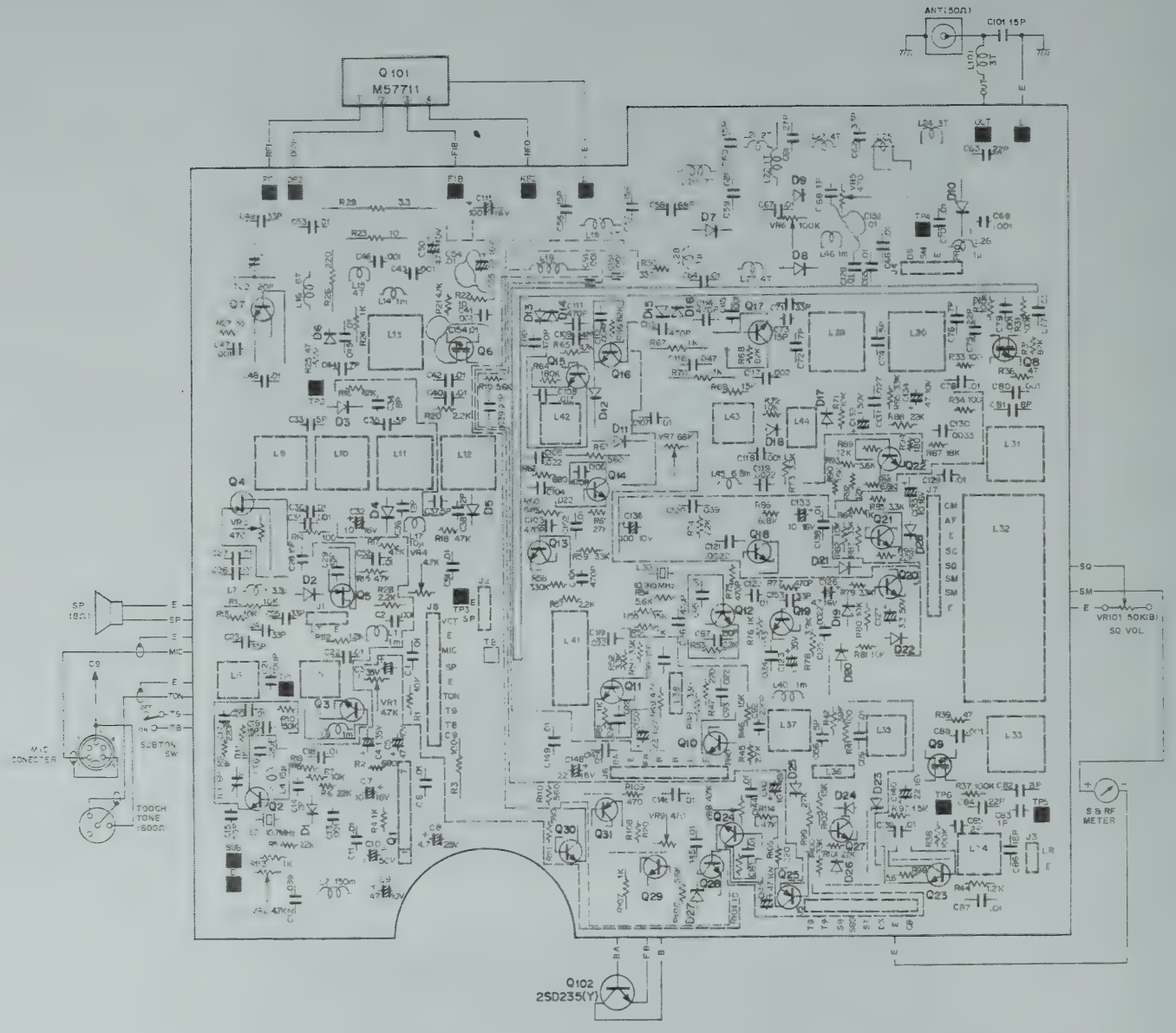


VIEWED FROM BOTTOM



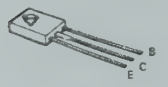
PC BOARD

■ TX-RX UNIT (X44-1300-10)



Q1	:TA7061AP	Q18,~22,28,29,30		D1~5,	:IS2208	D23	:XZ-088
Q2,3,10~17			:2SC1815(Y)	D6,13-16,21, 24,26,28	:IS1555	D25	:WZ-100
	:2SC460(B)	Q23,24	:2SC496(Y)	D7	:MI402	D27	:WZ-061
Q4,5	:2SK19(GR)	Q25	:2SA1015(Y)	D8	:IS2588		
Q6,8,9	:3SK74(L)	Q27	:2SC1959(Y)	D9~12,17,18,19, 20	:IN60		
Q7	:2SC2053	Q31	:2SA496(Y)	D22	:IS1212		

2SA496(Y)
2SC496(Y)



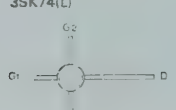
2SK19(GR)

2SC458(B)
2SC460(B)

2SA1015(Y)
2SC1815(Y)
2SC1959(Y)

2SD235(Y)

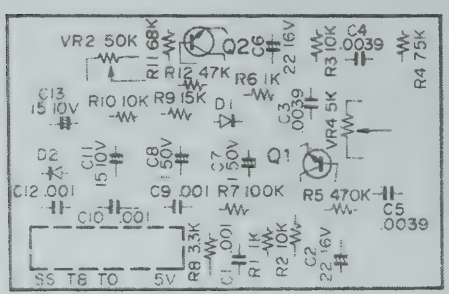
3SK74(L)



2SC2053

M57711

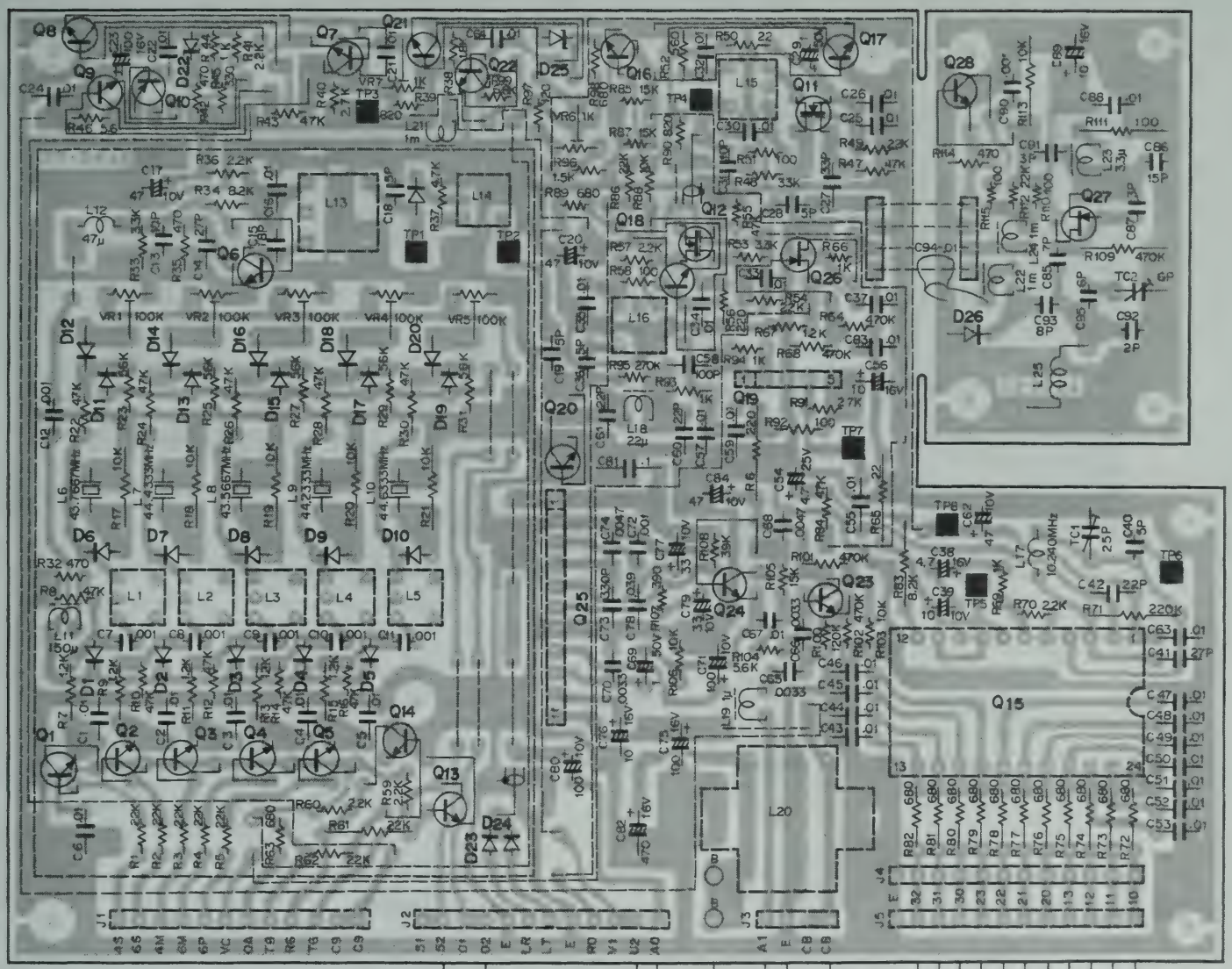
TONE UNIT (X62-1110-51) T TYPE

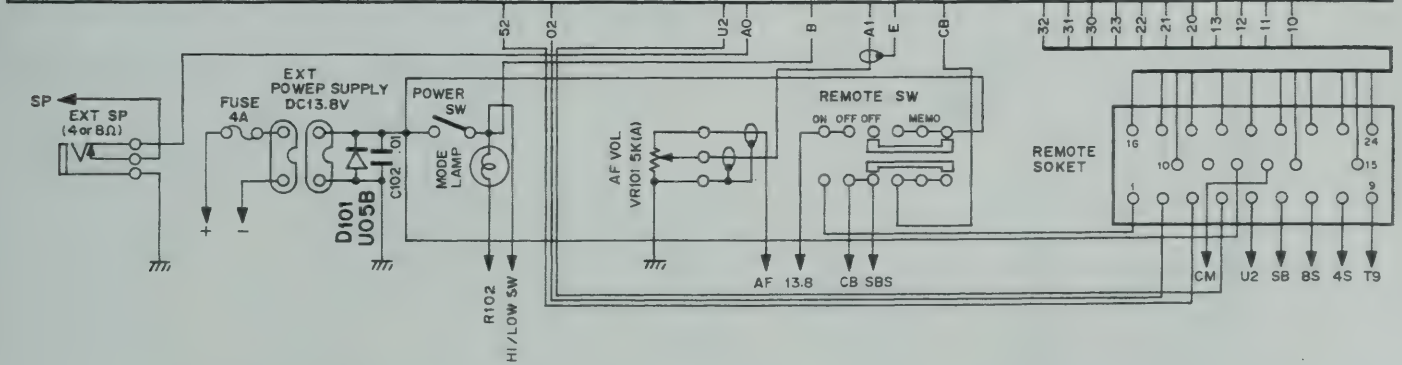


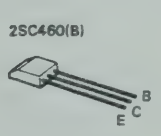
Q1,2 : 2SC458 (B)

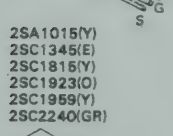
PC BOARD

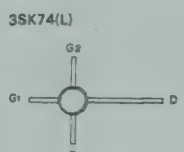
■ PLL UNIT (X50-1580-10)

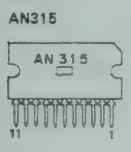


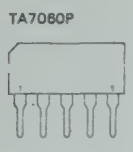


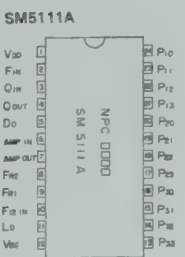










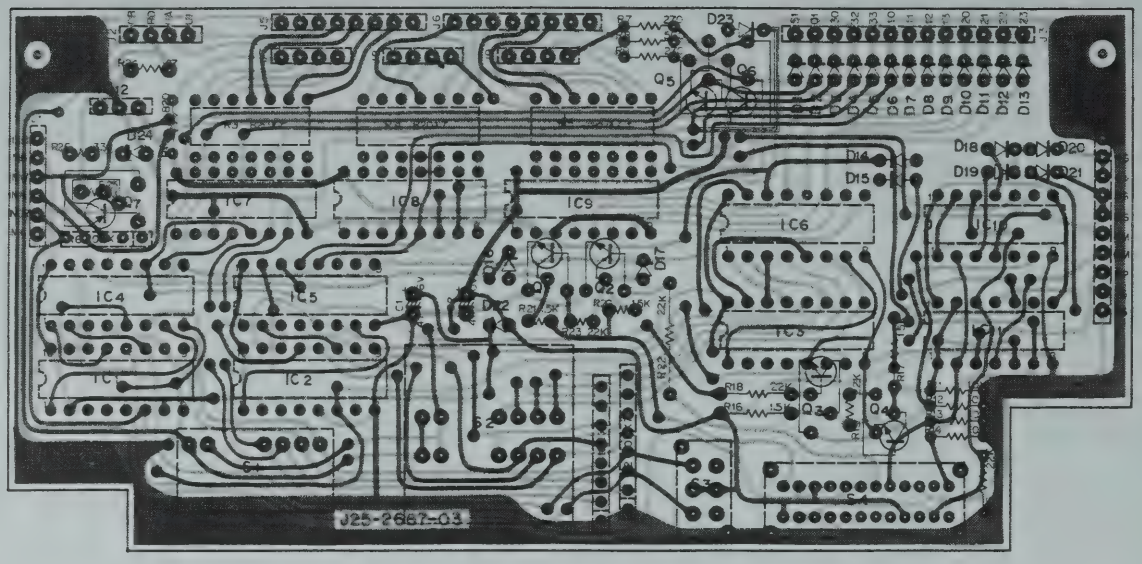


Q1~3,4,5,7,9,13,14,16,18,21,22	: 2SC1815 (Y)	Q25	: AN315
Q6	: 2SC460 (B)	Q26	: 2SK30A(GR)
Q9	: 2SC1959 (Y)	Q27	: 2SK19(GR)
Q10	: 2SA496 (Y)	D1~5	: 1S2588
Q11,12	: 3SK74 (L)	D6~10	: 1SV53A
Q15	: SM5111A	D11~20	: 1S1555
Q17	: 2SC1345(E)	D21	: 1SS16
Q19	: TA7060P	D22	: XZ-060
Q20,28	: 2SC1923(O)	D23~24	: 1S2588
Q23,24	: 2SC2240(GR)	D25	: WZ-040
		D26	: 1S2208

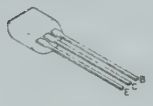
PC BOARD

■ CONTROL UNIT (X54-1380-00)

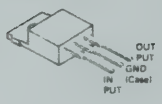
J25-2668-04



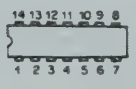
2SA1015(Y)
2SC1815(Y)



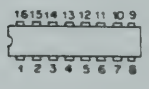
FS-7806M



TC4081P

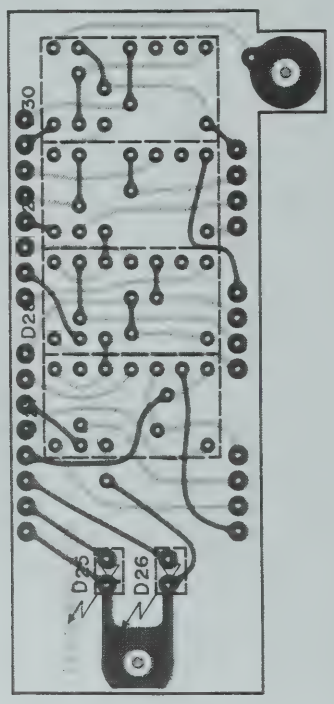


TC5022BP
TC4019BP
TC4035BP

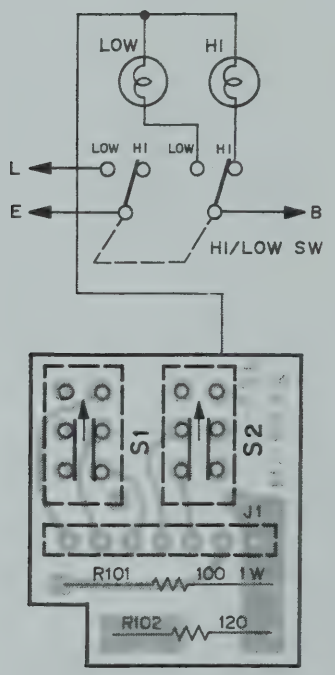


IC1~3	:TC4035BP	Q1~7	:2SC1815(Y)
IC4~6	:TC4019BP	Q7	:2SA1015(Y)
IC7~9	:TC5022BP	D1~13,15~22	:1N60
IC10, 11	:TC4081P×3/4	D23	:IS1555
IC10, 11	:TC4081P×1/4	D24	:WZ-150
IC12	:FS-7806M	D25	:TLG-205
		D26	:TLR-205
		D27~30	:5130K

J25-2668-04 (Indicator)



J25-2664-04 (Switch)



PARTS LIST

NOTE:
Except special types (example: cement, metal film, etc.) resistors are not detailed in the PARTS LIST. Regarding value, refer to the schematic diagram or the PC board illustration. Resistors not otherwise detailed are carbon type (1/4 or 1/8W).
Order carbon resistors according to the following example:
A carbon resistor's part number is RD14BY 2E222J.

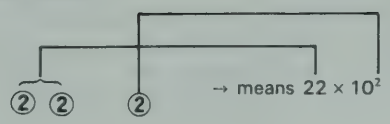
1. Type of the carbon resistor

RD14BY

RD14CY

2. Wattage
   1/4W → 2E
   1/8W → 2B

3. Resistance value



Significant figure Multiplier
Example:
221 → 220Ω
222 → 2.2kΩ
223 → 22kΩ
224 → 220kΩ
225 → 2.2MΩ

GENERAL

☆ : New parts

Ref. No.	Parts No.	Description		Remarks
		CAPACITORS		
C101	CC45SL2H150D	Ceramic 15pF ±0.5pF		
C102	CK45F1J103Z	Ceramic 0.01μF +80,−20%		
C103	CK45B1H221K	Ceramic 220pF ±10%		
C104	CC45SL1H181J	Ceramic 180pF ±5%		
		SEMICONDUCTOR		
Q101	V30-1030-36	Power module M57711		☆
Q102	V04-0046-05	Transistor 2SD235 (Y)		
D101	V11-0270-05	Diode V05B		
		COIL		
L101	L34-0821-05	(No care) 5φ3T		☆
		POTENTIOMETER		
VR101	R19-9403-05	15kΩ (A) 50k (B)		
		MISCELLANEOUS		
—	A01-0734-13	Case (A)		☆
—	A01-0735-03	Case (B)		☆
—	A20-2334-05	Die casting panel (Front)	(K)	☆
—	A20-2339-03	Die casting panel (Front)	(W)	☆
—	A20-2340-03	Die casting panel (Front)	(T)	☆
—	B05-0707-04	Speaker grill cloth		☆
—	B10-0615-04	Front glass		☆
—	B31-0616-05	Meter		☆
—	B30-0802-05	Plot lamp (white)		
—	B30-0803-05	Pilot lamp (Blue)		
—	B30-0106-05	Pilot lamp (Small)		
—	B42-1602-04	Sticker	(K)	
—	B46-0058-00	Warranty card	(K)	
—	B50-2614-00	Operating manual	(K)	☆
—	B50-2628-00	Operating manual	(W)	☆
—	B50-2629-00	Operating manual	(T)	☆
—	E04-0152-05	M type receptacle		
—	E06-0453-05	4P metal socket (MIC)	(W) (T)	☆
—	E06-0552-05	5P metal socket (MIC)	(K)	☆
—	E07-0451-05	4P metal consent	(W) (T)	☆
—	E07-0551-05	5P metal consent	(K)	☆
—	E08-0203-25	2P connector (Jack)		

Ref. No.	Parts No.	Description		Remarks
—	E08-0471-05	4P socket (TONE PAD)	(K)	
—	E09-0471-05	4P plug (TONE PAD)	(K)	
—	E09-0203-25	2P connector (Plug)		
—	E11-0003-15	Earphone jack		
—	E12-0061-05	Phone plug		
—	E23-0043-04	Antenna earth lag		
—	E23-0015-04	Earth lag		
—	F01-0731-05	Heat sink		☆
—	F05-4022-05	Fuse (4A) × 2		
—	F20-0078-05	Isulating plate		
—	F29-0014-05	Insulating washer		
—	G02-0505-05	Fitting spring for knob		
—	G11-0054-14	Insulating cushion × 2		
—	G13-0616-04	Cushion (A) × 2		☆
—	G13-0617-04	Cushion (B)		☆
—	H01-2590-03	Carton case (Inside)	(K) (W)	☆
—	H01-2607-03	Carton case (Inside)	(T)	☆
—	H10-2519-02	Cushion		☆
—	H10-2501-03	Styren foam cushion		
—	H12-0447-04	Cushion		☆
—	H20-1408-03	Protection cover		☆
—	H25-0049-03	Bag with accessory		
—	H25-0079-04	Polytylene bag (MIC)		
—	H25-0103-04	Polyetylene bag (Cord)		
—	J13-0029-05	Fuse holder		
—	J21-2608-03	C type angle		☆
—	J51-0006-15	Snap-lock × 2		
—	J61-0019-05	Vinyl tie		
—	K21-0724-04	Knob (Outside)		☆
—	K21-0731-03	Knob (Mode)	(K)	☆
—	K21-0732-03	Knob channel (A)		☆
—	K21-0733-03	Knob channel (B)		☆
—	K21-0741-03	Knob mode	(W) (T)	☆
—	K23-0717-04	Knob		☆
—	K23-0719-04	Knob MHz		☆
—	K29-0712-04	Knob push (square) × 2		☆
—	K29-0713-04	Knob push (circle) × 3		☆
—	N99-0304-04	Hex. socket screws × 4		☆
—	S31-1402-05	Slide switch (remote)		
—	S36-2402-05	See saw switch (power)		

PARTS LIST

Ref. No.	Parts No.	Description	Remarks
—	S40-2409-05	Push switch (M)	☆
—	S40-2404-05	Push switch (MR)	
—	S40-2403-05	Push switch SUB, HI/LOW (W) HI/LOW	
—	T07-0201-05	Speaker (8Ω)	
—	T91-0310-05	Microphone (K)	☆
—	T91-0302-05	Microphone (W)	
—	T91-0301-05	Microphone (T)	
—	W01-0401-04	Wrench (Hex)	☆
—	X44-1300-10	TX-RX unit	
—	X50-1580-10	PLL unit (K)	☆
—	X50-1580-61	PLL unit (W) (T)	☆
—	X52-1110-62	TONE unit (W)	☆
—	X52-1110-51	TONE unit (T)	☆
—	X54-1440-10	CONTROL unit (K)	☆
—	X54-1440-61	CONTROL unit (W) (T)	☆

TX-RX Unit (X44-1300-10)

Ref. No.	Parts No.	Description	Remarks
		CAPACITOR	
C1	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C2	CK45B1H102K	Ceramic 0.001μF ±10%	
C3,4	CS15E1V0R1M	Tantalum 0.1μF 16WV	
C5	CE04W1A470	Electrolytic 47μF 10WV	
C6	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C7	CE04W1C100	Electrolytic 10μF 16WV	
C8	CE04W1E4R7	Electrolytic 4.7μF 25WV	
C9	CE04W1A470	Electrolytic 47μF 10WV	
C10	CE04W1H010	Electrolytic 1μF 50WV	
C11	CQ92M1H103K	Mylar 0.01μF ±10%	
C12	CQ92M1H393	Mylar 0.039μF ±10%	
C13	CK45B1H102K	Mylar 0.001μF ±10%	
C14	CC45UJ1H020C	Ceramic 2pF ±0.25pF	
C15	CC45TH1H100D	Ceramic 10pF ±0.5pF	
C16,17	CK45B1H221K	Ceramic 220pF ±10%	
C18	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C19	CC45CH1150J	Ceramic 15pF ±5%	
C20	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C21	CC45SL1H101J	Ceramic 100pF ±5%	
C22	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C23～25	CC45CH1H330J	Ceramic 33pF ±5%	
C26,27	CK46F1H103Z	Ceramic 0.01μF +80,−20%	
C28,29	CC45TH1H150J	Ceramic 15pF ±5%	
C30	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C31	CK45B1H102K	Ceramic 100pF ±10%	
C32	CE04W1C100	Electrolytic 110μF 16WV	
C33	CC45CH1H050C	Ceramic 5pF ±0.25pF	
C34	CC45TH1H080D	Ceramic 8pF ±0.5pF	
C35	CC45CH1HOR5C	Ceramic 0.5pF ±0.25pF	
C36	CC45TH1H120J	Ceramic 12pF ±5%	
C37	CC45CH1HOR5C	Ceramic 0.5pF ±0.25pF	
C38	CC45TH1H120J	Ceramic 12pF ±5%	
C39	CC45CH1H270J	Ceramic 27pF ±5%	
C40	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C41	CK45B1H102K	Ceramic 0.001μF ±10%	
C42	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C43	CK45B1H102K	Ceramic 0.001μF ±10%	
C44	CC45CH1H070D	Ceramic 7pF ±0.5pF	
C45	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C46,47	CK45B1H102K	Ceramic 0.001μF ±10%	
C48	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C49	CC45CH1H330J	Ceramic 33pF ±5%	
C50	CE04W1A470	Electrolytic 47μF 100WV	
C51～54	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C55	CE04W1C220	Electrolytic 22μF 16WV	
C56,57	CC45SL2H150J	Ceramic 15pF ±5%	
C58,59	CC45SL2H680J	Ceramic 68pF ±5%	
C60	CC45SL2H150J	Ceramic 15pF ±5%	
C61	CC45SL2H270J	Ceramic 27pF ±5%	
C62	CC45SL2H330J	Ceramic 33pF ±5%	
C63	CC45SL2H220J	Ceramic 22pF ±5%	
C64～67	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C68	CC45CH1H010C	Ceramic 1pF ±0.25pF	
C69	CK45B1H102K	Ceramic 0.001μF ±10%	
C70	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C71	CC45CH1H330J	Ceramic 33pF ±5%	
C72	CC45RH1H070D	Ceramic 7pF ±0.5pF	
C73	CC45LH1H150J	Ceramic 15pF ±5%	
C74	CC45CH1H050C	Ceramic 5pF ±0.25pF	
C75	CC45CH1H220J	Ceramic 22pF ±5%	
C76	CC45RH1H070D	Ceramic 7pF ±0.5pF	
C77,78	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C79,80	CK45B1H102K	Ceramic 0.001μF ±10%	
C81,82	CM93F2A080D	Mica 8pF ±0.5pF	
C83	CC45SL1H010C	Ceramic 1pF ±0.25pF	
C84	CC45CH1H220J	Ceramic 22pF ±5%	
C85	CC45CH1H020C	Ceramic 2pF ±0.25pF	
C86	CC45CH1H180J	Ceramic 18pF ±5%	
C87	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C88	CK45B1H102K	Ceramic 0.001μF ±10%	
C89	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C91	C91-0405-05	Trough type capacitor 0.001μF	
C92	CK45B1H221K	Ceramic 220pF ±10%	
C93,94	CQ92M1H223K	Mylar 0.022μF ±10%	
C95	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C96	CK45B1H471K	Ceramic 470pF ±10%	
C97	CC45SL1H151J	Ceramic 150pF ±5%	
C98	CC45CH1H150J	Ceramic 15pF ±5%	
C99	CQ92M1H223K	Mylar 0.022μF ±10%	
C101	CK45B1H471K	Ceramic 470pF ±10%	
C102	CQ92M1H103K	Mylar 0.01μF ±10%	
C103	CK45B1H471K	Ceramic 470pF ±10%	
C104,105	CQ92M1H223K	Mylar 0.022μF ±10%	
C106	CK45B1H471K	Ceramic 470pF ±10%	
C107	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C108	CQ92M1H153K	Mylar 0.015μF ±10%	
C109	CC45CH1H470J	Ceramic 47pF ±5%	
C110,111	CK45B1H471K	Ceramic 470pF ±10%	
C112	CQ92M1H472K	Mylar 0.0047μF ±10%	
C113,114	CK45B1H471K	Ceramic 470pF ±10%	
C115	CQ92M1H102K	Mylar 0.001μF ±10%	
C116	CQ92M1H473K	Mylar 0.047μF ±10%	
C117	CQ92M1H223K	Mylar 0.022μF ±10%	
C118	CQ92M1H102K	Mylar 0.001μF ±10%	
C119	CQ92M1H222K	Mylar 0.0022μF ±10%	
C120	CQ92M1H393K	Mylar 0.039μF ±10%	
C121	CQ92M1H222K	Mylar 0.0022μF ±10%	
C122	CQ92M1H103K	Mylar 0.01μF ±10%	
C123	CS15E1VOR1M	Tantalum 0.1μF 16WV	
C124	CQ92M1H333K	Mylar 0.033μF ±10%	
C125	CQ92M1H222K	Mylar 0.0022μF ±10%	
C126	CS15E1C4R7M	Tantalum 4.7μF 16WV	
C127	CE04W1H3R3	Electrolytic 3.3μF 50WV	
C128	CK45F1H103Z	Ceramic 0.01μF +80,−20%	

PARTS LIST

Ref. No.	Parts No.	Description	Remarks
C129	CQ92M1H103K	Mylar 0.01μF ±10%	
C130	CQ92M1H332K	Mylar 0.0033μF ±10%	
C131	CQ92M1H273K	Mylar 0.027μF ±10%	
C132	CE04W1H010	Electrolytic 1μF 50WV	
C133	CE04W1C100	Electrolytic 10μF 16WV	
C134	CE04W1A470	Electrolytic 47μF 10WV	
C135	CE04W1C100	Electrolytic 10μF 16WV	
C136	CE04W1A101	Electrolytic 100μF 10WV	
C138,139	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C140	CE04W1C220	Electrolytic 22μF 16WV	
C141	CK451H103Z	Ceramic 0.01μF +80,−20%	
C142	CE04W1C100	Electrolytic 10μF 16WV	
C143	CE04W1A470	Electrolytic 47μF 10WV	
C144～147	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C148	CE04W1C220	Electrolytic 22μF 16WV	
C149	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C150	CE04W1C220	Electrolytic 22μF 16WV	
C151	C91-0405-05	Trough type capacitor 0.001μF	
C152	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C153	CC45SL1H330J	Ceramic 33pF ±5%	
C154	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C155	CE04W1C101Q	Electrolytic 100μF 16WV	
C156	CC45CH1H050C	Ceramic 5pF ±0.25pF	
C157～159	CC45TH1H020C	Ceramic 2pF ±0.25pF	
RESISTOR			
R29	RS14GB3D3R3J	Resistor (Metal Film) 3.3Ω	
SEMICONDUCTOR			
Q1	V03-0039-05	IC TA7061AP	
Q2,3	V03-0079-05	Transistor 2SC460 (B)	
Q4,5	V09-0012-05	FET 2SK19 (GR)	
Q6	V09-1002-56	FET 3SK74 (L)	
Q7	V03-2053-06	Transistor 2SC2053	☆
C8,9	V09-1002-56	FET 33K74 (L)	
Q10～17	V03-0079-05	Transistor 2SC460 (B)	
Q18～22	V03-1815-06	Transistor 2SC1815 (Y)	
Q23,24	V03-0336-05	Transistor 2SC496 (Y)	
Q25	V01-1015-06	Transistor 2SA1015 (Y)	
Q27	V03-1959-06	Transistor 2SC1959 (Y)	☆
Q28～30	V03-1815-06	Transistor 2SC1815 (Y)	
Q31	V01-0113-05	Transistor 2SA496 (Y)	
D1～5	V11-0317-05	Diode 1S2208	
D6	V11-0076-05	Diode 1S1555	
D7	V11-5260-16	Diode MI402	
D8	V11-0414-05	Diode 1S2588	
D9～12	V11-0051-05	Diode 1N60	
D13～16	V11-0076-05	Diode 1S1555	
D17～20	V11-0051-05	Diode 1N60	
D21	V11-0076-05	Diode 1S1555	
D22	V11-1262-06	Varistor 1S1212	
D23	V11-4163-56	Zener diode XZ-088	
D24	V11-0076-05	Diode 1S555	
D25	V11-0247-05	Zener diode WZ-100	
D26	V11-0076-05	Diode 1S1555	
D27	V11-0243-05	Zener diode WZ-061	
D28	V11-0076-05	Diode 1S1555	
POTENTIOMETER			
VR1,2	R12-1404-05	Potentiometer P6-S3NA 4.7kΩ	
VR3	R12-0406-05	Potentiometer P6-S3NA 470Ω	

Ref. No	Parts No.	Description	Remarks
VR4	R12-1404-05	Potentiometer P6-S3NA 4.7kΩ	
VR5	R12-0406-05	Potentiometer P6-S3NA 470Ω	
VR6	R12-5403-05	Potentiometer P6-S3NA 100kΩ	
VR7	R12-4404-05	Potentiometer P6-S3NA 68kΩ	
VR8	R12-1404-05	Potentiometer P6-S3NA 4.7kΩ	
VR9	R12-0406-05	Potentiometer P6-S3NA 470Ω	
TRIMMER			
TC1	C05-0062-05	Ceramic trimmer 6pF ECV1ZW6P	
TC2	C05-0013-15	Ceramic trimmer 20pF ECV1ZW20P	
COIL/INDUCTOR/CRYSTALQUARTZ			
L1	L40-1021-03	Ferri inductor 1mH	
L2	L40-1545-06	Ferri inductor 150mH	
L3	L77-0710-05	Crystal quartz (10.7 MHz)	
L4	L33-0615-05	Choke coil 15μH	
L5	L30-0005-05	IFT	
L6	L31-0313-05	IFT	
L7	L40-3391-03	Ferri inductor 3.3μH	
L8	L40-1021-03	Ferri inductor 1 mH	
L9	L31-0344-05	Tuning coil	
L10	L31-0180-05	Tuning coil	
L11,12	L31-0267-05	Tuning coil	
L13	L34-0672-05	Tuning coil	
L14	L40-1021-03	Ferri inductor 1 mH	
L15	L34-0814-05	VHF coil 4φ4T	☆
L16	L34-0452-05	VHF coil 3φ6T	
L17	L40-1001-03	Ferri inductor 10μH	
L18	L33-0074-05	Choke coil 0.3μH	
L19	L34-0813-05	VHF coil 4φ3T	☆
L20	L34-0819-05	VHF coil 5φ7T	☆
L21	L34-0816-05	VHF coil 5φ2T	☆
L22	L34-0815-05	VHF coil 5φ1T	☆
L23	L34-0814-05	VHF coil 4φ4T	☆
L24	L34-0817-05	VHF coil 5φ3T	☆
L25	L39-0052-05	Inspecting coil	
L26	L33-0002-05	Choke coil 1μH	
L27	L34-0818-05	VHF coil 5φ4T	☆
L28	L33-0025-05	Choke coil 1μH	
L29,30	L34-0694-05	Tuning coil	
L31	L34-0812-012	Tuning coil	☆
L32	L79-0451-05	Helical block	☆
L33	L34-0812-05	Tuning coil	☆
L34	L34-0683-05	Tuning coil	☆
L35	L30-0289-05	IFT	
L36	L71-0201-05	Monolitic filter 10F15A	
L37	L30-0289-05	IFT	
L38	L72-0014-05	Ceramic filter SFE-10.7 MA5	
L39	L77-0327-05	Crystal quartz (10.245 MHz)	
L40	L40-1021-03	Ferri inductor 1 mH	
L41	L72-0309-05	Ceramic filter CFT-455FZ	
L42	L30-0504-05	IFT	
L43	L30-0503-05	IFT	
L44	L79-0442-05	Ceramic discri 455-D	
L45	L40-6825-04	Ferri inductor 6.8 mH	
L46	L40-1021-03	Ferri inductor 1 mH	
MISCELLANEOUS			
	E23-0046-04	Terminal (square) × 16	
	E23-0401-05	Terminal (circle)	

PARTS LIST

PLL Unit (X50-1580-10)

Ref. No.	Parts No.	Description	Remarks
CAPACITOR			
C1～6	CK451H103Z	Ceramic 0.01μF +80,−20%	
C7～12	CJ45B1H102K	Ceramic 0.001μF ±10%	
C13	CC45CH1H100D	Ceramic 10pF ±0.5pF	
C14	CC45CH1H270J	Ceramic 27pF ±0.5%	
C15	CC45UJ1H180J	Ceramic 18pF ±5%	
C16	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C17	CE04W1A470	Electrolytic 47μF 10WV	
C18,19	CC45LH1H050C	Ceramic 5pF ±0.25pF	
C20	CE04W1A470	Electrolytic 47μF 10WV	
C21,22	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C23	CE04W1C101Q	Electrolytic 100μF 16WV	
C24～26	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C27	CC45CH1H330J	Ceramic 33pF ±5%	
C28	CC45CH1H050C	Ceramic 5pF ±0.25pF	
C29	CE04W1H010	Electrolytic 1μF 50WV	
C30	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C31	CC45CH1H100D	Ceramic 10pF ±0.5pF	
C32～35	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C36	CC45CH1H050C	Ceramic 5pF ±0.25pF	
C37	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C38	CS15E1C4R7M	Tantalum 4.7μF 16WV	
C39	CS15E1A100M	Tantalum 10μF 10WV	
C40	CC45CH1H050C	Ceramic 5pF ±0.25pF	
C41	CC45CH1H270J	Ceramic 27pF ±0.5%	
C42	CC45CH1H220J	Ceramic 22pF ±5%	
C43～53	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C54	CE04W1E4R7	Electrolytic 4.7μF 25WV	
C55	C90-0246-05	Ceramic 0.01μF ±10%	
C56	CE04W1C100	Electrolytic 10μF 16WV	
C57	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C58	CC45SL1H101J	Ceramic 100pF ±5%	
C59	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C60,61	CC46CH1H220J	Ceramic 22pF ±5%	
C62	CE04W1A470	Electrolytic 47μF 10WV	
C63,64	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C65,66	CQ92M1H332K	Mylar 0.0033μF ±10%	
C67	CQ92M1H103K	Mylar 0.01μF ±10%	
C68	CQ92M1H472K	Mylar 0.0047μF ±10%	
C69	CE04W1H010	Electrolytic 1μF 50WV	
C70	CQ92M1H332K	Mylar 0.0033μF ±10%	
C71	CE04W1A101Q	Electrolytic 100μF 10WV	
C72	CQ92M1H102K	Mylar 0.001μF ±10%	
C73	CK453B1H331K	Ceramic 330pF ±10%	
C74	CQ92M1H472K	Mylar 0.0047μF ±10%	
C75	CE04W1C101Q	Electrolytic 100μF 16WV	
C76	CE04W1C100	Electrolytic 10μF 16WV	
C77	CE04W1A330	Electrolytic 33μF 10WV	
C78	CQ92M1H303K	Mylar 0.039μF ±10%	
C79	CE04W1A330	Electrolytic 33μF 10WV	
C80	CE04W1A101Q	Electrolytic 100μF 10WV	
C81	CQ92M1H104K	Mylar 0.1μF ±10%	
C82	CE04W1C471Q	Electrolytic 470μF 16WV	
C84	CE04W1A470	Electrolytic 47μF 10WV	
C85	CC45CH1H070D	Ceramic 7pF ±0.5pF	
C86	CC45CH1H150J	Ceramic 15pF ±5%	
C87	CC45CH1H030C	Ceramic 3pF ±0.25pF	
C88	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C89	CE04W1C100	Electrolytic 10μF 16WV	
C90	CK45B1H102K	Ceramic 0.001μF ±10%	
C91	CC45CH1H030C	Ceramic 3pF ±0.25pF	
C92	CC45UJ2H020C	Ceramic 1pF ±0.25pF	
C93	CC45CH1H080D	Ceramic 8pF ±0.5pF	
C94	CQ92M1H103K	Mylar 0.01μF ±10%	
C95	CC45UJ1H060D	Ceramic 6pF ±0.5pF	
SEMICONDUCTOR			
Q1～5	V03-1815-06	Transistor 2SC1815 (Y)	
Q6	V03-0079-05	Transistor 2SC460 (B)	
Q7,8	V03-1815-06	Transistor 2SC1815 (Y)	
Q9	V03-1959-06	Transistor 2SC1959 (Y)	
Q10	V01-0113-05	Transistor 2SA496 (Y)	
Q11,12	V09-1002-56	FET 3SK74 (L)	
Q13,14	V03-1815-06	Transistor 2SC1815 (Y)	
Q15	V30-1030-46	IC SM5111A	☆
Q16	V03-1815-06	Transistor 2SC1815 (Y)	
Q17	V03-0272-05	Transistor 2SC1345 (E)	
Q18	V03-1815-06	Transistor 2SC1815 (Y)	
Q19	V30-0087-05	IC TA7060P	
Q20	V03-1923-06	Transistor 2SC1923 (O)	☆
Q21,22	V03-1815-06	Transistor 2SC1815 (Y)	
Q23,24	V03-2240-06	Transistor 2SC2240 (GR)	
Q25	V30-0208-05	IC AN315	
Q26	V09-0060-05	FET 2SK30A (GR)	
Q27	V09-1001-16	FET 2SK19 (GR) (T)	
Q28	V03-1923-06	Transistor 2SC1972 (O)	☆
D1～5	V11-0414-05	Diode 1S2588	
D6～10	V11-4161-36	Diode 1SV53A	
D11～20	V11-0076-05	Diode 1S1555	
D21	V11-0374-05	Diode 1SS16	
D22	V11-4161-16	Zener diode XZ-061	
D23,24	V11-0414-05	Diode 1S2588	
D25	V11-4161-56	Zener diode WZ-040	☆
D26	V11-0317-05	Diode 1S2208	
POTENTIOMETER			
VR1～5	R12-5403-05	Potentiometer 100kΩ	
VR6,7	R12-1403-05	Potentiometer 1kΩ	
TRIMMER			
TC1	C05-0067-05	Ceramic trimmer 5P	
TC2	C05-0062-05	Ceramic trimmer 6P	
COIL/INDUCTOR			
L1～5	L34-0437-05	Choke coil	☆
L6	L77-0832-05	Crystal quartz 43.7667 MHz	☆
L7	L77-0833-05	Crystal Quartz 44.4333 MHz	☆
L8	L77-0834-05	Crystal Quartz 43.5667 MHz	☆
L9	L77-0835-05	Crystal Quartz 44.2333 MHz	☆
L10	L77-0836-05	Crystal Quartz 44.6333 MHz	☆
L11	L40-1511-03	Ferri-inductor 150μH	
L12	L33-0605-05	Choke coil 0.47μH	
L13	L32-0002-05	Oscillator coil	
L14	L34-0683-05	Tuning coil	
L15	L34-0820-05	Tuning coil	☆
L16	L34-0683-05	Tuning coil	
L17	L77-0720-05	Crystal Quartz 10.240 MHz	
L18	L40-2201-03	Ferri-inductor 22μH	
L19	L40-1091-03	Ferri-inductor 1μH	
L20	L15-0016-05	Choke coil (Low frequency)	
L21,22	L40-1021-03	Ferri-inductor 1mH	
L23	L40-3391-03	Ferri-inductor 3.3μH	
L25	L32-0618-05	Oscillator coil	☆
MISCELLANEOUS			
	E23-0046-04	Terminal × 8 (square)	
	E23-0401-05	Terminal × 2 (circle)	

PARTS LIST/PACKING

CONTROL UNIT (X54-1440-10)

Ref. No.	Parts No.	Description	Remarks
		CAPACITOR	
C1	CE04W1C470Q	Electrolytic 47μF 16WV	
C2	CE04W1A470	Electrolytic 47μF 10WV	
R1,2	R90-0514-05	Resistor block 10k × 7	
R3～5	R90-0516-05	Resistor network	
R6	R90-0515-05	Resistor block 10k × 4	
Q1～6	V03-1815-06	Transistor 2SC1815 (Y)	
Q7	V01-1015-06	Transistor 2SC1015 (Y)	
IC1～3	V30-1006-46	IC TC4035BP	☆
IC4～6	V30-0232-26	IC TC4019BP	
IC7～9	V30-0232-76	IC TC5022BP	
IC10,11	V30-1006-36	IC TC4081BP	☆
IC12	V30-1025-26	IC FS7806M	☆
D1～22	V11-0051-05	Diode 1N60	
D23	V11-0076-05	Diode 1S1555	
D24	V11-0307-05	Zenner diode WZ-150	
D25	V11-3162-86	LED TLG205	☆
D26	V11-3162-96	LED TLR205	☆
D27～30	V11-4161-66	LED 513 OK	☆
S1	S29-1406-05	Rotary switch (1 MHz) K	☆
S4	S29-1408-05	Rotary switch (1 MHz) W	☆
S2	S29-1405-05	Rotary switch (1000 kHz, 10 kHz)	☆
S3	S40-2405-05	Push switch (0k, 5k)	
S4	S29-4402-05	Slide rotary (for shift)	☆

TONE UNIT (X52-1110-50) (T TYPE) (X52-1110-61) (W TYPE)

Ref. No.	Parts No.	Description	Remarks
C1	CD45B1H102K	Ceramic 1000pF ±10%	
C2	CE04W1C220Q	Electrolytic 22μF 16WV	
C3～5	C91-0433-05	Layer-built 0.0039μF ±5%	☆
C6	CE04W1C220Q	Electrolytic 22μF 16WV	
C7,8	CE04W1H010	Electrolytic 1μF 50WV	
C9,10	CK45B1H102K	Ceramic 1000pF ±10%	
C11	CS15E1A150K	Tantalum 15μF ±10%	(T)
C12	CK45B1H102K	Ceramic 1000pF ±10%	
C13	CS15E1A150K	Tantalum 15μF ±10%	(T)
		RESISTOR	
R1～12	RD14CB2E○○○J But	Carbon ○○○Ω ±5% 1/W	
R2,3	R92-0616-05	Metal film 10kΩ ±1% 1/W	☆
R4	R92-0617-05	Metal film 7.5kΩ ±1% 1/W	☆
R5	RN14BK2E4703F	Metal film 470kΩ ±1% 1/W	
R10	RD14CB2E102J	Carbon 15kΩ ±5% 1/W	(T)
		SEMICONDUCTOR	
Q1,2		Transistor 2SC458 (B)	
D1,2		Diode 1S1555	(T)
D1		Diode 1S1555	(W)
		POTENTIOMETER	
VR1	R12-2405-05	Semi-fixed resistor 5kΩ	☆
VR2	R12-4403-05	Semi-fixed resistor 50kΩ	(T)☆
		MISCELLANEOUS	
—	E40-0464-05	Pin plug	

PACKING

ACCESSORIES SUPPLIED

1. Dynamic microphone equipped with
   5-pin plug (T91-0310-05) (K)..... 1 piece
   4-pin plug (T91-0301-05) (T)
   4-pin plug (T91-0302-05) (W)
2. Mounting bracket (J21-2608-03)..... 1 piece
3. Mounting parts
   Hex. socket screws (N99-0304-04)..... 4 pieces
   Screws, 6 mm diameter (N09-0008-04)..... 4 pieces
   Plain washers, 6 mm diametr
   (N15-1060-46)..... 4 pieces
   Spring washers, 6 mm diameter
   (N16-0060-41)..... 4 pieces
   Nuts, 6 mm diameter (N14-0009-04) ..... 4 pieces
4. Snap-lock (J51-0006-15) ..... 2 pieces
5. Label ..... 1 sheet
6. Spare fuse, 4A (F05-1031-05)..... 1 piece
7. DC power cord with plug and fuse..... 1 piece
8. Miniature plug for external speaker
   (E12-0001-05) and touch tone pad
   (E08-0471-05) ..... 2 pieces
   (E09-0471-05)
9. Operating manual (B50-2614-00) (K) ..... 1 copy
   (B50-2628-00) (W)
   (B50-2629-00) (T)

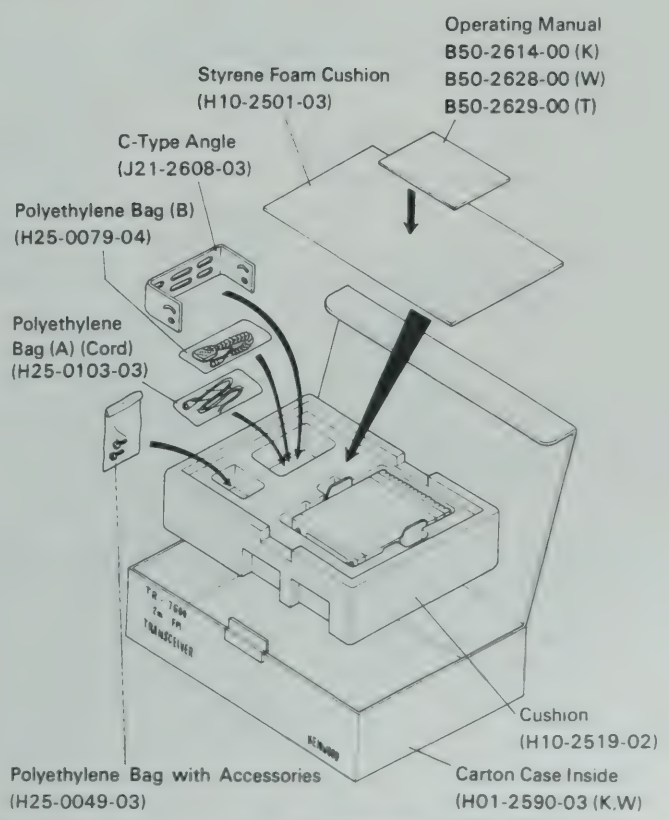


Fig. 9 Packing

EXPLODED VIEW

I. Removing the case
(1) Remove the bind screws ① ~ ⑪.
(2) Remove the upper and 2 lower cases.

II. Removing the panel
(1) Remove the knobs.
(2) Remove the screws Ⓐ ~ Ⓓ

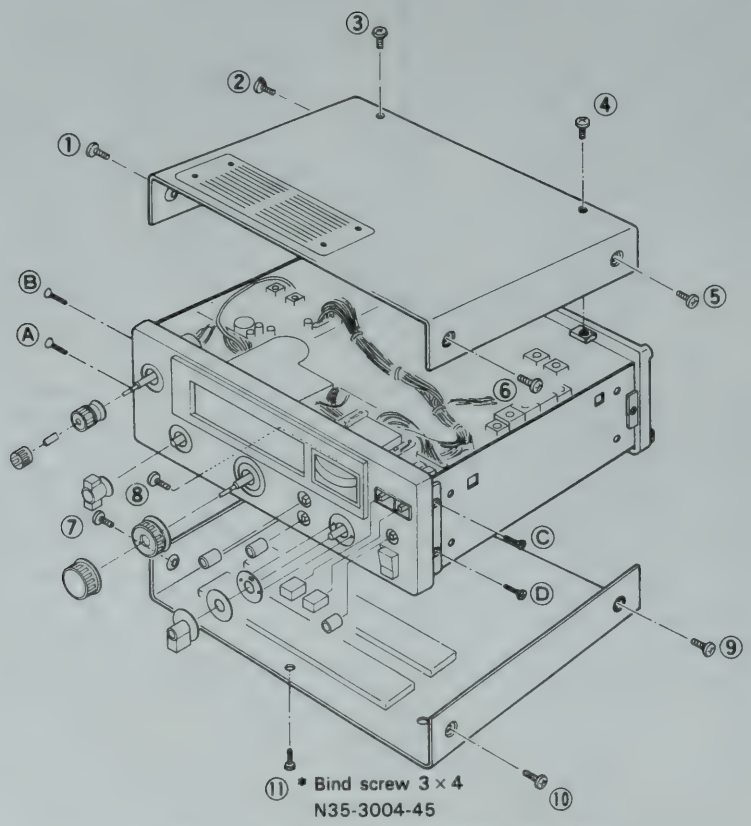


Fig. 10 Removing the Panel and Case

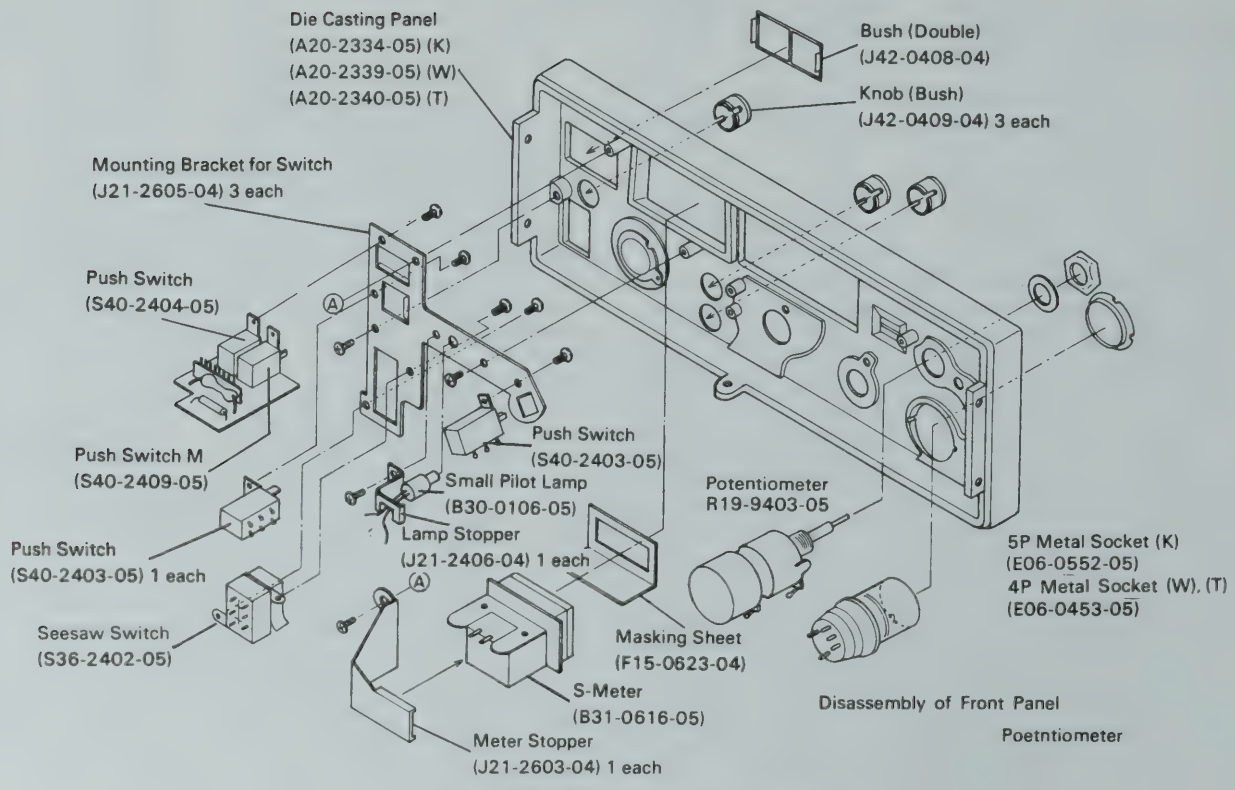
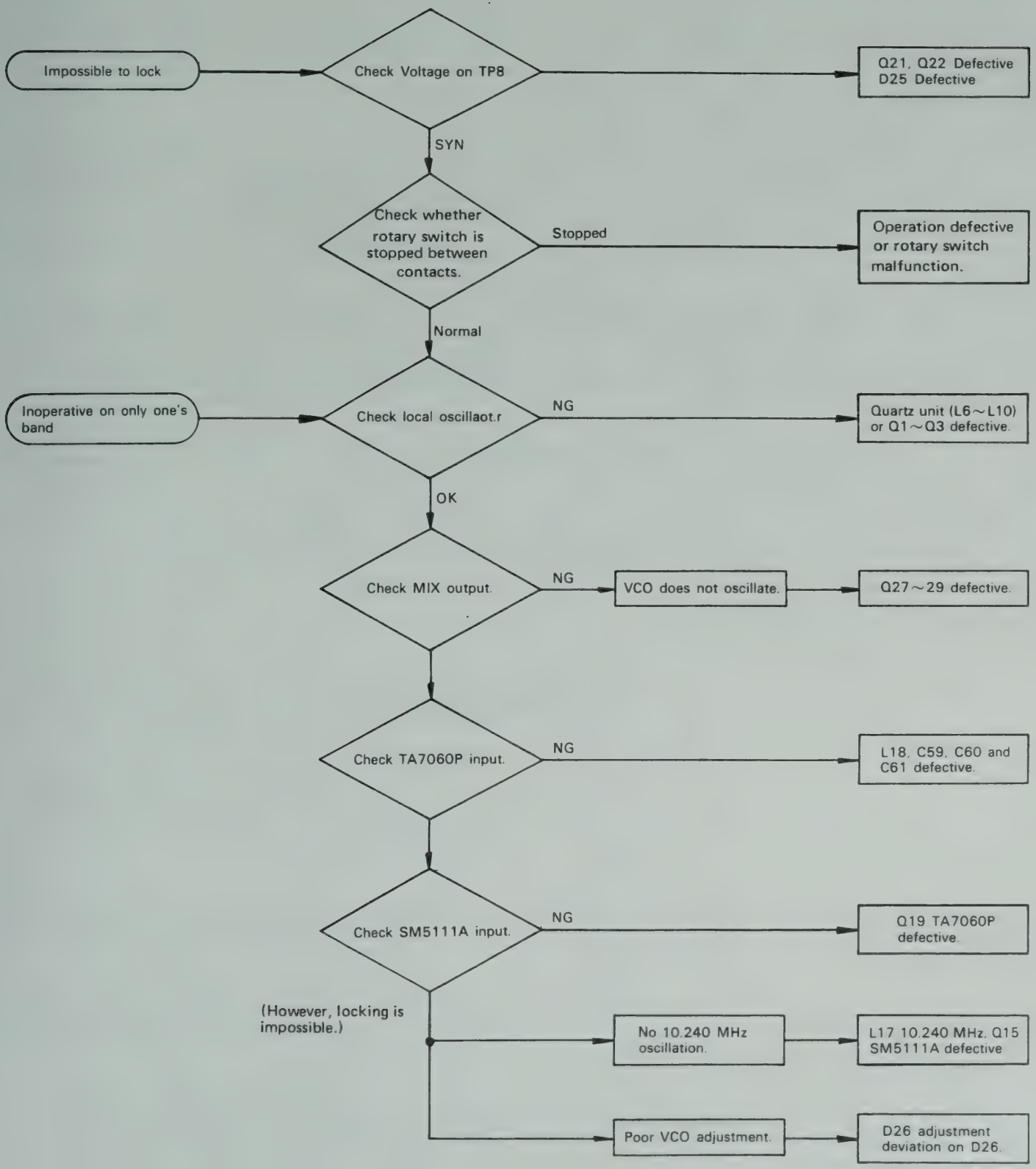


Fig. 11 Disassembly of Front Panel

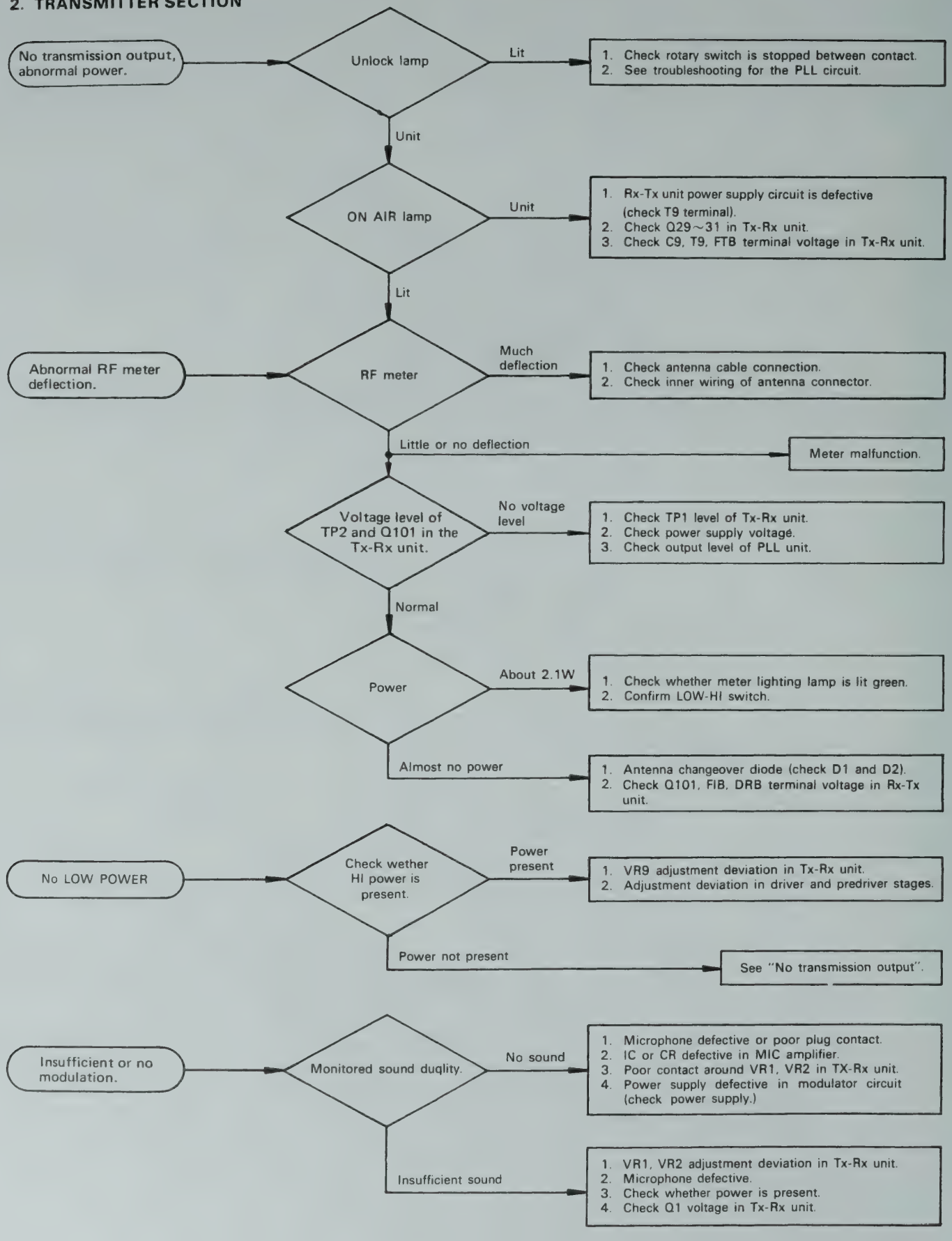
TROUBLESHOOTING

1. PLL CIRCUIT



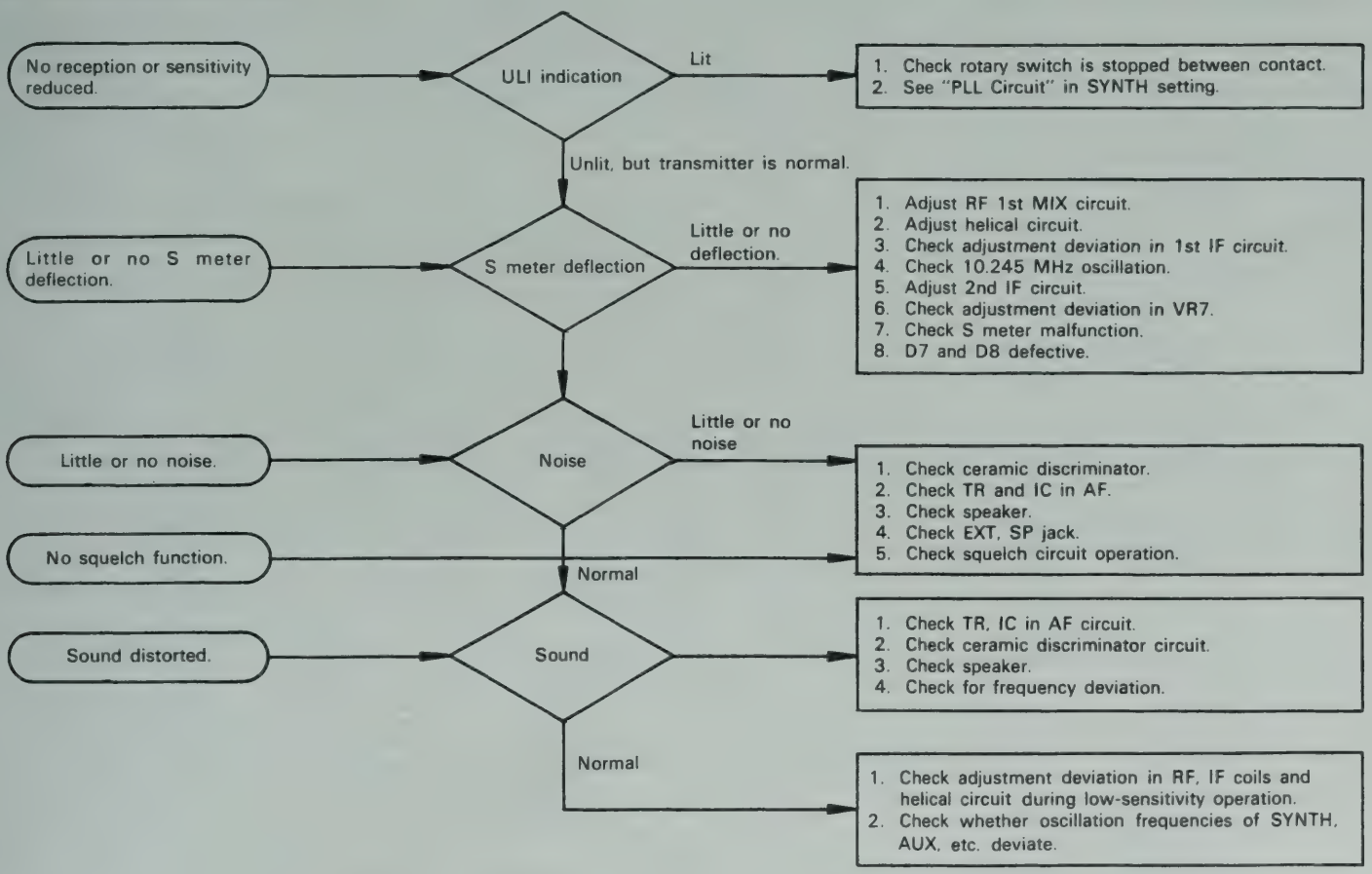
TROUBLESHOOTING

2. TRANSMITTER SECTION



TROUBLESHOOTING/ADJUSTING

3. RECEIVER SECTION



ADJUSTMENT

TEST EQUIPMENT REQUIRED

1. DC Power Supply
- Voltage: Variable from 9 to 16 V.
- Current: 4 A min.

2. DC Voltmeter
- Voltage range: 10 V～16 V (min.)
- Input inpedance: Sufficient (1MΩ/VDC)

3. RF Valve Voltmeter
- Voltage range: F.S. 10 mV～300 V
- Measuring frequency: 200 MHz min.
- Input impedance: 1 MΩ min., 3 pF max.

4. Frequency Counter
- Measuring frequency: 150 MHz min.
- Min. input sensitivity: about 50 mV

5. Oscilloscope:
With horizontal input terminal and high sensitivity,
- Measuring frequency: 3 MHz min.

6. Power Meter
- Measuring frequency: 150 MHz min.
- Impedance: 50Ω
- Measuring range: 20W, 3W

7. Linear Detector

8. AG
- Frequency range: 300 Hz～5 kHz
- Output: 0.5 mV～1 V

9. AF Valve Voltmeter
- Measuring frequency: 50 Hz 10 kHz
- Input impedance: 1 MΩ min.
- Voltage range: F.S. 3 mV～30 V

10. SSG
- Output frequency: Capable of covering 144 MHz ～148 MHz
- Modulation: Frequency modulation is possible.

11. Sweep Generator
- Frequency range: Capable of covering 144 MHz ～148 MHz

12. Dummy
8Ω 5W (approx.)

13. Directional Coupler

14. Detector

ADJUSTMENT

1. Adjustment of PLL circuit

Item	Condition	Measuring point			Adjusting point			Reference	Remarks
		(Measure instruments)	Unit	Terminal	Unit	Parts	Method		
1. Voltage check and adjustment	1) POWER SW: ON HI/LOW SW: HI MR SW: OFF MODE SW: S MHz SW: 6 100 kHz SW: 0 10 kHz SW: 0 SUBTONE SW: O 5Hz SW: 0 REMOTE SW OFF SEND/REC SW: SEND	DC V M	PLL	T9 (J1)				8.9V～10.2V	Confirm
			TX.RX	T9				8.9V～10.2V	Confirm
				EB				Approx. 12V	Confirm
	2) SEND/REC SW: REC	DC V.M	TX RX	R9				7.7V～8.3V	Confirm
	3) Same as above.	DC V.M	PLL	TP3	PLL	VR7	8.0V	±0.2V	
	4) Same as item 2)	DC V M	PLL	TP8	PLL	VR6	6.0V	±0.2V	
2. PLL	1) 100 kHz SW: 0 10 kHz SW: 0	RF V.M	PLL	TP1	PLL	L13	Turn the L13 core counter clockwise (180°) from the oscillation start point	0.46V	
				TP7		L14 L16	MAX	1.4V	
	2) MHz SW: 4	DC V.M	PLL	TP5	PLL	TC2	1.5V	±0.05V	
	3) MHz SW: 7 100 kHz SW: 9 10 kHz SW: 9	DC V.M	PLL	TP5				Less than 5.5V	Confirm
	4) Same as above	F.Count	PLL	TP6	PLL	TC1	10.24000 Hz	±100 Hz	
	5) MHz SW: 4 100 kHz SW: 0 10 kHz SW: 0 5 kHz SW: 5 kHz	Frequency Counter	PLL	TP4	PLL	L1	133.3050 MHz	±100 Hz	
	6) MHz SW: 6					L2	135.3050 MHz	±100 Hz	
	7) MHz SW: 5 MODE SW: ⊖					L3	133.7050 MHz	±100 Hz	
	8) MHz SW: 7					L4	135.7050 MHz	±100 Hz	
	9) MODE SW: ⊕					L5	136.9050 MHz	±100 Hz	
Calibration of counter at 10.24 MHz	When a frequency counter is connected to the TP6 of the PLL unit, the 10.24 MHz signal is devited because of the impedance, so the counter should be calibrated using the following procedure MHz SW: 4 100 kHz SW: 0 10 kHz SW: 0 ↓ MHz SW: 5	Frequency Counter	PLL	TP4	PLL	TC1	With the MHz SW set to "4" and "5" check that the signal on the TP6 is 10.24 MHz at each position when the TC1 is adjusted so that the signal of 100 Hz order on the TP4 remains unchanged.		
	10) MHz SW: 4 5 kHz SW: 0 MODE SW: S SEND/REC SW: REC		PLL	TP4	PLL	VR1	133.3000 MHz	±100 Hz	
	11) MHz SW: 6					VR2	135.3000 MHz	±100 Hz	
	12) MHz SW: 5 MODE SW: ⊖ SEND/REC SW: SEND					VR3	133.7000 MHz	±100 Hz	
	13) MHz SW: 7					VR4	135.7000 MHz	±100 Hz	
	14) MODE SW: ⊕ Recheck the frequencies in Item (5) through (9). If they are devited, readjust L1 through L5					VR5	136.9000 MHz	±100 Hz	

ADJUSTMENT

Item	Condition	Measuring point			Adjusting point			Reference	Remarks
		(Measure instruments)	Unit	Terminal	Unit	Parts	Method		
	15) MHz SW: 5 100 kHz SW: 9 10 kHz SW: 9 MODE SW: S SEND/REC. SW: REC		PLL	TP4				135.2900 MHz±100 Hz	Confirm
	16) MHz SW: 7							137.2900 MHz ±100 Hz	Confirm
	17) MHz SW: 5 MODE SW: ⊖ SEND/REC. SW: SEND							134.6900 MHz±100 Hz	Confirm
	18) MHz SW: 7							136.6900 MHz±100 Hz	Confirm
	19) MHz SW: 4 100 kHz SW: 0 10 kHz SW: 0							132.7000 MHz±100 Hz	Confirm
	20) MHz SW: 6	Frequency Counter	PLL	TP4				134.7000 MHz±100 Hz	Confirm
	21) MHz SW: 5 SEND/REC. SW: REC.							134.3000 MHz±100 Hz	Confirm
	22) MHz SW: 7							136.3000 MHz±100 Hz	Confirm
	23) MHz SW: 6 MODE SW: ⊕							135.9000 MHz±100 Hz	Confirm
	24) MHz SW: 7 SEND/REC. SW: REC.							136.3000 MHz±100 Hz	Confirm
	25) MHz SW: 4 SEND/REC. SW: SEND & REC.							133.3000 MHz±100 Hz	Confirm
	26) MHz SW: 5 SEND/REC. SW: SEND & REC.							134.3000 MHz±100 Hz	Confirm
	27) MHz SW: 4→5→6→7→4 MODE SW: S SEND/REC. SW: REC.		PLL	TP4				The frequency should become higher than 133.3000 MHz in 1 MHz steps and should return to the original frequency at the "4" position.	Confirm
	28) 100 kHz SW: 0 → 1 → ..... 9 → 0							The frequency should become higher than 133.3000 MHz in 100 kHz steps and should return to the original frequency at the "0" position.	Confirm
	29) 10 kHz SW: 0 → 1 → ..... 9 → 0							The frequency should become higher than 133.3000 MHz in 10 kHz steps and should return to the original frequency at the "0" position.	Confirm
	30) MHz SW: 6 SEND/REC. SW: SEND	RF V.M	PLL	TP4	PLL	L15	MAX		
3. Paint lock	1) L1. L2. L3. L4. L5. L13								

ADJUSTMENT

2. Adjustment of TX section

Item	Condition	Measuring point			Adjusting point			Reference	Remarks
		(Measure instruments)	Unit	Terminal	Unit	Parts	Method		
1. SET	1) POWER SW: ON HI/LOW SW: HI MR SW: OFF MODE SW: S MHz SW: 4 100 kHz SW: 0 10 kHz SW: 0 5 kHz SW: 0 SUBTONE SW: OFF REMOTE SW: OFF SEND/REC. SW: SEND TC 1: Centered TC 2: Centered VR8: Full counter clockwise (FCCW)								
2 10.7 MHz	1) Ready for UNLOCK	RF V.M	TX.RX	TP1	TX.RX	L5.L6	MAX	0.4 V	
	2) Same as above	F.Counter	TX.RX	TP1	TX.RX	TC1	10.7000 MHz	±100 Hz	
3. VCT	1) Ready for UNLOCK MHz SW: 4 → 5 → 6 → 7	DC V.M	TX.RX	TP3				Check voltage goes down step by step	Confirm
4 BPF DRIVE	1) MHz SW: 6	RF V.M	TX.RX	gate	TX.RX	L9. 10 L11. VR3	MAX Repeat the same procedure two or three times.	1.2 V	Adjust the setting range of RF voltmeter for peak value.
	2) MHz SW: 7 100 kHz SW: 9 10 kHz SW: 9	RF V.M	TX.RX	TP2	TX.RX	L12. 13	Repeat the same procedure two or three times.		
	3) MHz SW: 4 100 kHz SW: 0 10 kHz SW: 0	RF V.M.	TX.RX	RFI	TX.RX	L13	MAX		Use to RF prove 100 : 1
5 POWER	1) POWER SW: OFF Power module lead: Soldering a RFT terminal.								
	2) MHz SW: 6 100 kHz SW: 0 10 kHz SW: 0 POWER SW: ON	POWER METER			TX.RX	TC2	MAX		
	3) Same as above	POWER. M DC A.M	rear panel	ANT.	TX.RX	L19	Adjust for 12W (if the power is less than 12 W make adjustment according to the procedure in Item (4) below.	Less than 3.0A	
	4) Same as above	POWER.M DC A.M			TX.RX	TC2	Adjust L19 to increase to capacity		
	5) MHz SW: 4	POWER M DC A M						More than 10 W	Confirm
	6) MHz SW: 7 100 kHz SW: 9 10 kHz SW: 9	POWER.M DC A.M						More than 10 W Less than 3 A	Confirm
6 RF METER	1) MHz SW: 6 100 kHz SW: 0 10 kHz SW: 0 TX.RX unit VR6: Center	RF METER	front panel		TX.RX	L21 L22	Adjust L22 so that meter indicates "8" on the scale		
	2) Same as above	RF METER			TX.RX	VR6	Meter indicates "8".		
7 LOW POWER	1) HI/LOW SW: LOW	POWER.M panel			TX.RX	VR9	1.2W	Check that the meter lamp changes from to green.	
	2) MHz SW: 4	POWER M						0.8 W ~ 1.5 W	
	3) MHz SW: 7 100 kHz SW: 9 10 kHz SW: 9	POWER.M	rear panel	ANT.				0.8W ~ 1.5W Power check output	Confirm

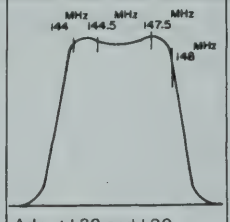
ADJUSTMENT

Item	Condition	Measuring point			Adjusting point			Reference	Remarks
		(Measure instruments)	Unit	Terminal	Unit	Parts	Method		
8. Output at the 11.5V (power supply)	1) DC Terminal: 11.5 V	POWER METER	rear panel	ANT.				Power check output	Confirm
	2) MHz SW: 6 10 kHz SW: 0 100 kHz SW: 0							Check power output	Confirm
	3) MHz SW: 4							Check power output	Confirm
	4) HI/LOW SW: HI							More than 6.0W	Confirm
	5) MHz SW: 6							More than 6.0W	Confirm
	6) MHz SW: 7 100 kHz SW: 9 10 kHz SW: 9							More than 6.0W	Confirm
9. Frequency SET	1) DC Terminal: 13.8V								
	2) MHz SW: 6 100 kHz SW: 0 10 kHz SW: 0	Frequency Counter	rear panel	ANT M coupling	TX.RX	TC1	146.000 MHz	±200 Hz	
10. Protection	1) Connect the Power Meter to the ANTENNA	DC V.M	TX.RX	TP4	TX.RX	VR5	MIN		
	2) Disconnect the Power to the ANTENNA TX.RX unit VR8: near centered	DC A.M	front panel		TX.RX	VR8	1.2A Check that the power is decrease when the power meter is disconnected		
	3) MHz SW: 4	DC A.M						Approx. 1.2A	Confirm
	4) MHz SW: 7 100 kHz SW: 9 10 kHz SW: 9	DC A.M					Approx. 1.2A	Approx. 1.2A	Confirm
	5) Connect the power meter to the ANTENNA.	POWER.M	rear panel	ANT.				Power output go on again.	Confirm
11. Deviation	1) MHz SW: 6 100 kHz SW: 0 10 kHz SW: 0 AG OUTPUT: 30 mV/ 1 kHz	Linear Detector			TX.RX	VR2	5.0 kHz		
	2) AG OUTPUT: 3 mV/ 1 kHz	Linear Detector			TX.RX	VR1	3.5 kHz		
12. SUBTONE	1) MIC Terminal: OPEN SEND/REC. SW: SEND AG OUTPUT: 300 mV/ 1 kHz SUBTONE SW: ON	Linear Detector		SUB G >AG TB.. DC V.M				1) Check that output waveform from the Linear Detector 2) Confirm that TV Terminal Voltage is approx. 10V	Confirm
13. Abnormal Oscillation	1) Same as above	Linear Detector						Very the power voltage from 11.5 to 16 V for each item to check for abnormal oscillation	
	2) HI/LOW SW: LOW								
	3) MHz SW: 4								
	4) HI/LOW SW: HI								
	5) MHz SW: 7 100 kHz SW: 9 10 kHz SW: 9								
	6) HI/LOW SW: LOW								
14. Shift & Memory Shift	1) MHz SW: 5 100 kHz SW: 0 10 kHz SW: 0 5 kHz SW: 0 HI/LOW SW: HI DC terminal: 13.8V MODE SW: ⊖ SEND/REC. SW: SEND MR SW: OFF	F.Count	rear panel	ANT. M coupling				144.400 MHz	
	2) MODE SW: ⊕	F.Count	rear panel	ANT				145.000 MHz	Confirm
	3) MHz SW: 7 MODE SW: ⊖	F.Count	rear panel	ANT				146.400 MHz	Confirm
	4) MODE SW: ⊕	F.Count	rear panel	ANT				147.600 MHz	Confirm
	5) MODE SW: S M SW (NON-LOCK): ON								Confirm

ADJUSTMENT

Item	Condition	Measuring point			Adjusting point			Reference	Remarks
		(Measure instruments)	Unit	Terminal	Unit	Parts	Method		
	6) MHz SW: 4 MODE SW: M (green)	F.Count	rear panel	ANT.				147.000 MHz Check that indication "7.000"	Confirm
	7) MODE SW: S	F.Count	rear panel	ANT.				144.000 MHz	Confirm
	8) MR SW: ON	F.Count	rear panel	ANT.				147.000 MHz Check that indication "7.000".	Confirm
15 Paint lock	1) L10, L11, L12, L13								

3. Adjustment of Receiver section

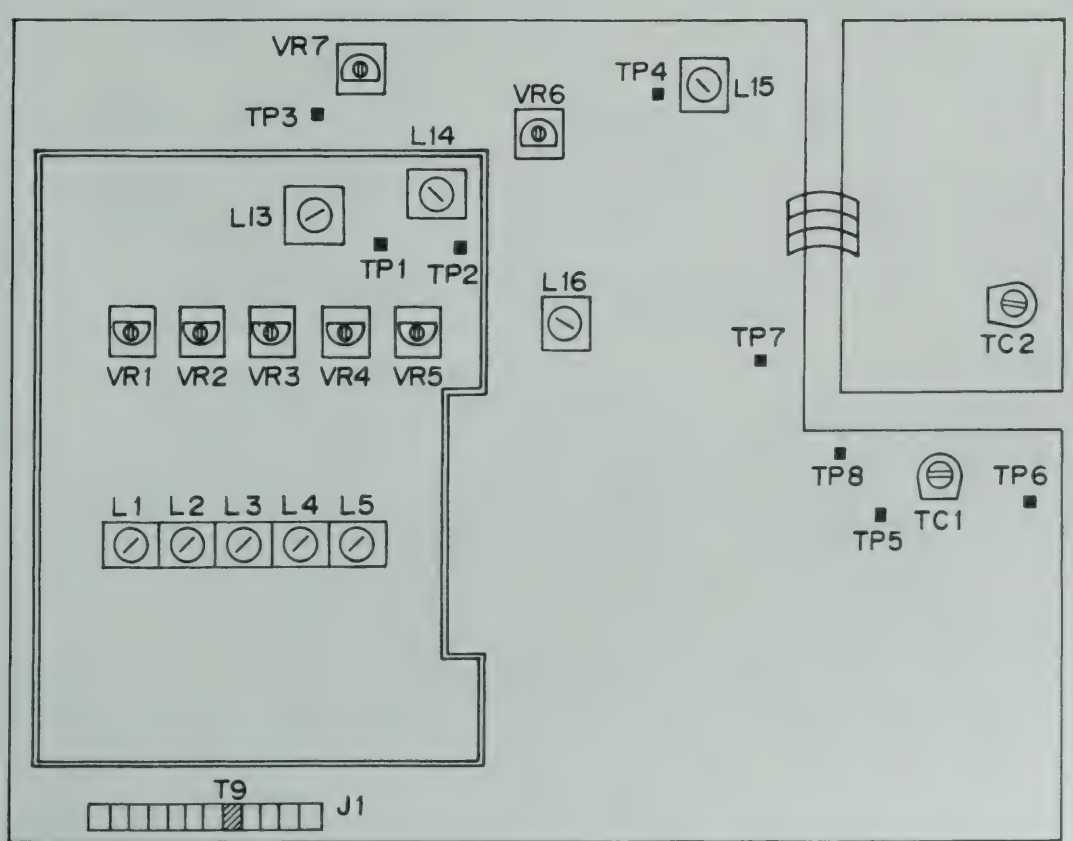
Item	Condition	Measuring point			Adjusting point			Reference	Remarks
		(Measure instruments)	Unit	Terminal	Unit	Parts	Method		
1. SETTING	1) POWER SW: ON HI/LOW SW: LOW MR SW: OFF MODE SW: S MHz SW: 5 100 kHz SW: 9 10 kHz SW: 5 5 kHz SW: 0 SUBTONE SW: OFF REMOTE SW: ON SEND/REC. SW: REC. SQUELCH VR. MIN EXT SP (terminal) AF V.M (8Ω) Oscilloscope								
2. Herical block	1) ANT terminal: SWEEP Oscilloscope VERT.GAIN: MAX	Oscillo- scope (Detector)	TX.RX	TP5	TX.RX	L29,30 L31 L32 (abc) (L33)	Adjust for a maximum gain and for a waveform as shown at right Adjust L29 and L30 for a maximum waveform Adjust L31, L32 (a.b.c) and L33 for a proper bandwidth and optimum waveform.	 Adjust L29 and L30 the waveform is distroted as shown below 	Repeat
3. IF GAIN	1) REMOTE SW: OFF ANT UNIT: SSG (DEV.: 5 kHz MOD 1 KHz SSG OUTPUT: Approx. 10 dB AF VR: 0.63 V/8Ω	AF V M					Adjust SSG for correct frequency and set it to optimum waveform		
	2) SSG OUTPUT. 5～10 dB	S METER			TX.RX	L34,35 L37	MAX Repeat the same procedure two or three times		
4 S METER	1) SSG OUTPUT 30 dB	S METER			TX.RX	VR7	Set the scale 10 (30 V)	30 dB±4 dB	
5 Discriminator	1) SSG OUTPUT 0 dB	AF V M			TX.RX	L43	MAX		

ADJUSTMENT/PC BOARD ALIGNMENT

Item	Condition	Measuring point			Adjusting point			Reference	Remarks
		(Measure instruments)	Unit	Terminal	Unit	Parts	Method		
6. S/N (Signal to Noise ratio)	1) SSG OUTPUT: −6 dB 2) MHz SW: 4 100 kHz SW: 0 10 kHz SW: 0	AF V.M					With a signal received at each channel, set AF V.M to 0.63 V/8 Ω. Next turn the SSG modulation OFF and measure the attenuation by AF V.M	S/N 20 dB	Confirm
	3) MHz SW: 7 100 kHz SW: 9 10 kHz SW: 9	AF V.M					With a signal received, set AF V.M to 0.63V/8Ω. Next, turn the SSG modulation by AF V.M.	S/N 20 dB	Confirm
	4) MHz SW: 5 10 kHz SW: 9 SSG OUTPUT: 40 dB	AF V.M					With a signal received, set AF V.M to 0.63V/8Ω.	S/N 40 dB	Confirm
							Next, turn the SSG modulation OFF and measure the attenuation by AF V.M.		
7. SQUELCH	1) SSG OUTPUT: OFF SQV. VR: Critical point	Oscillo-scope (or SP)						Critical point 9:00～11:00	Confirm
	2) SSG OUTPUT: −8 dB SQU. VR: Position of item (1)	Oscillo-scope (or SP)						When a signal of −8 dB is applied from the SSG. the squelch should open	Confirm

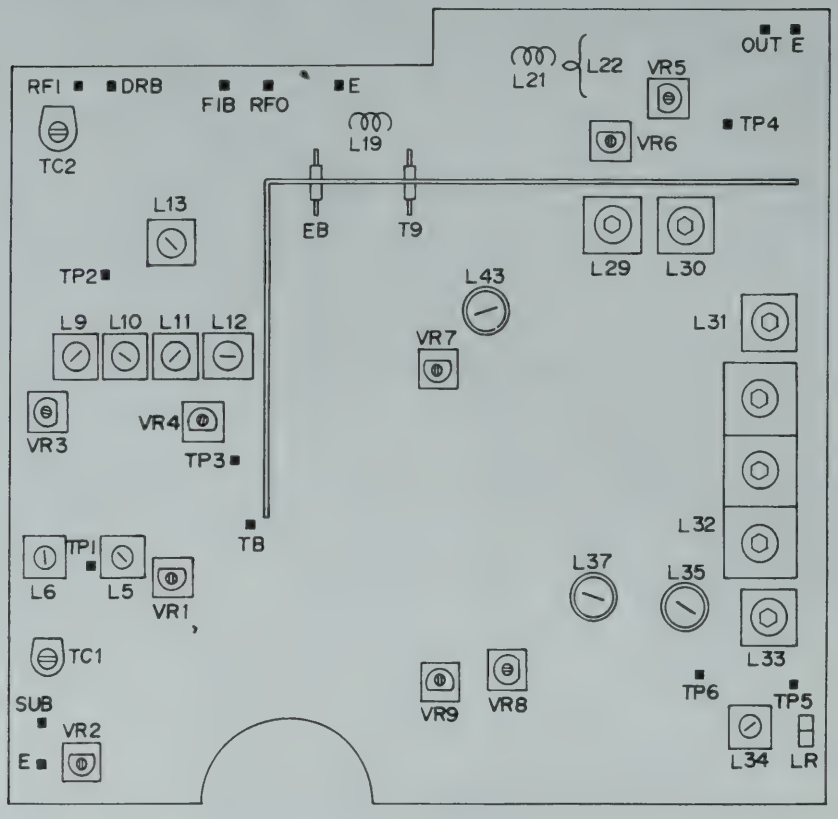
PC BOARD ALIGNMENT

PLL Unit (X50-1380-10)

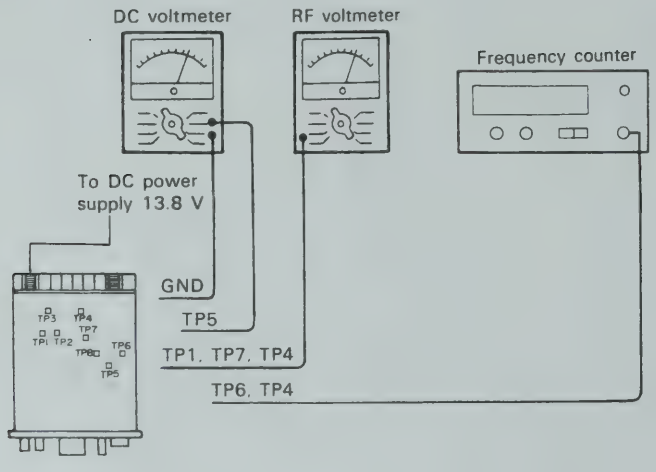


PC BOARD ALIGNMENT

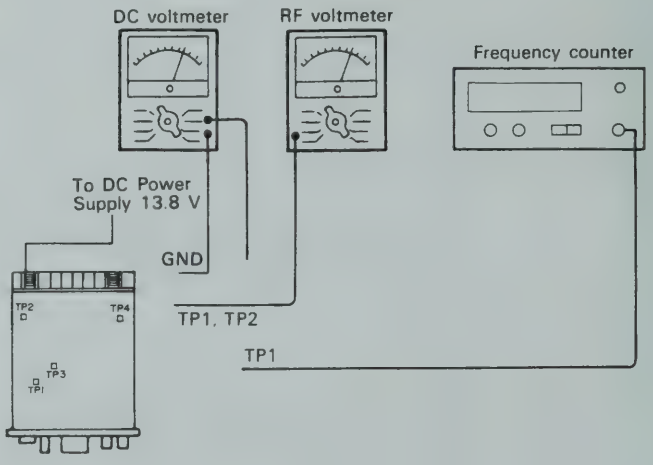
TX, RX Unit (X44-1300-10)



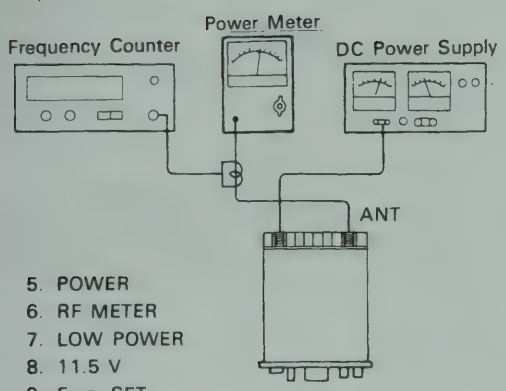
1. Adjustment of PLL Block



2. Tx Section adjustment

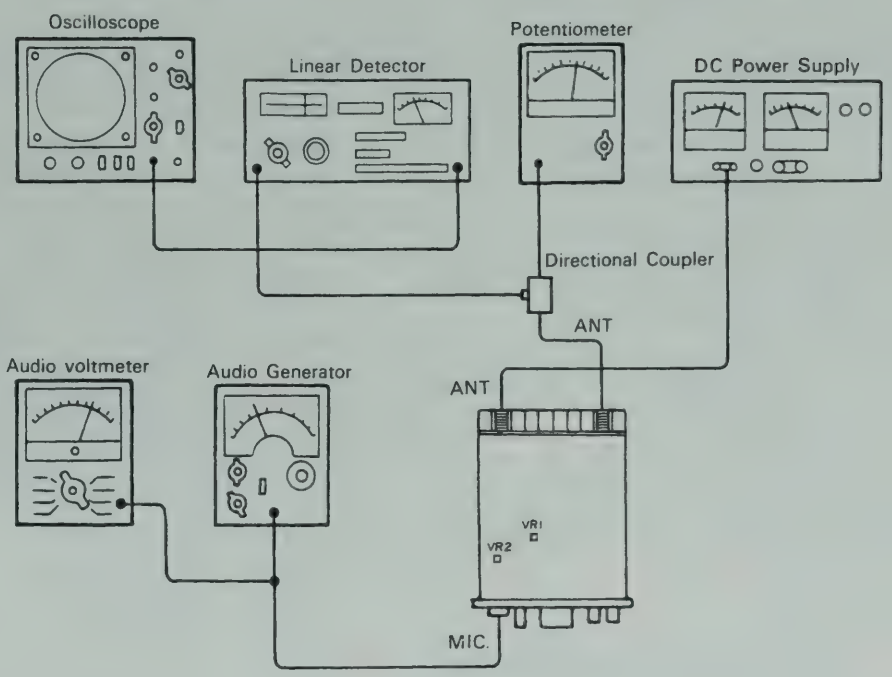


PC BOARD ALIGNMENT

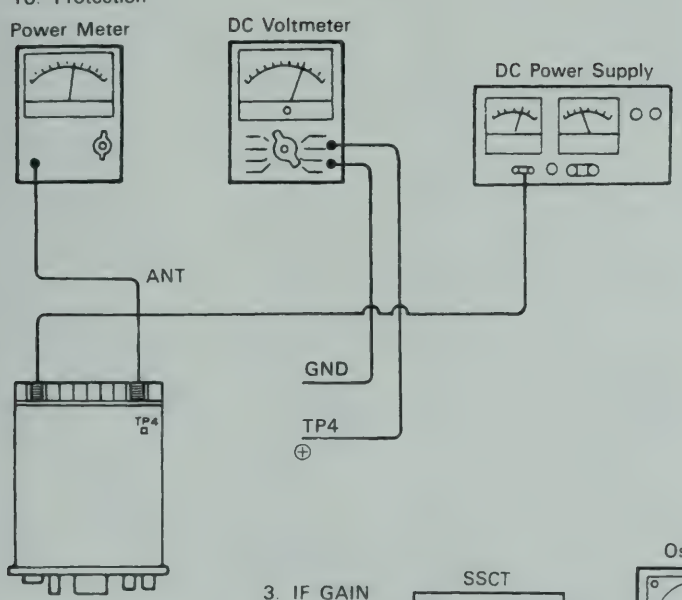


5. POWER
6. RF METER
7. LOW POWER
8. 11.5 V
9. Freq. SET
13. SHIFT AND MEMORY SHIFT

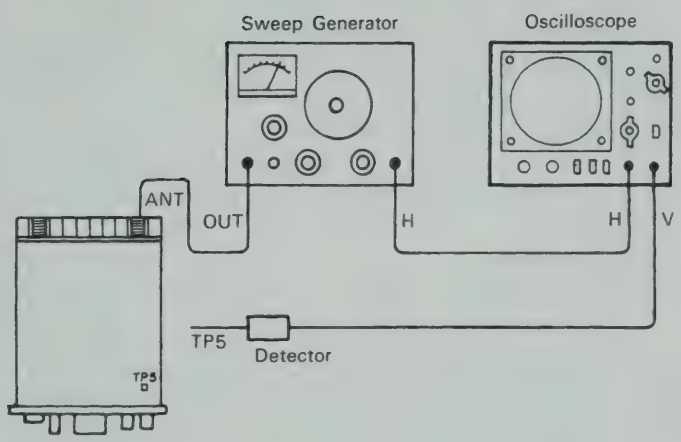
11. DEVIATION
12. ABNORMAL OSCILLATION



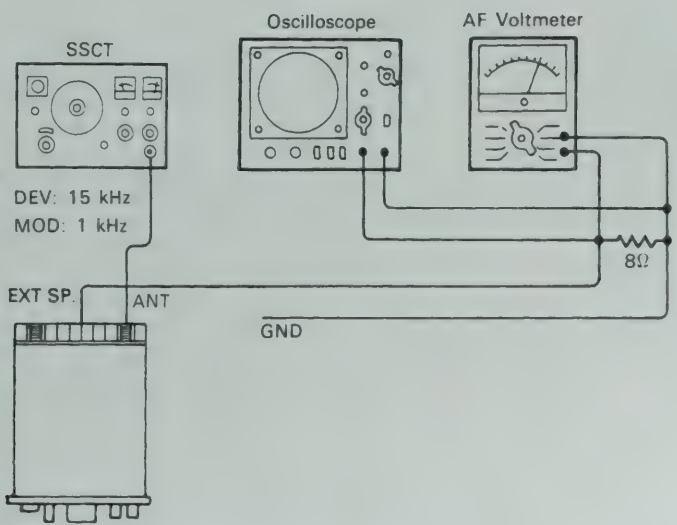
10. Protection



2. Helical



3. IF GAIN
4. S METER
5. Discretion
6. S/N
7. SQUELCH



SPECIFICATIONS

GENERAL

Semiconductors:	Transistors: 53 FETs: 9 ICs: 17 Diodes: 85
Frequency Range:	144.00 to 147.995 MHz
Frequency Synthesizer:	Digital control of phase locked VCO
Synthesizer Stability:	Less than ±750 Hz at 25°C
Mode:	FM
No. of Channels:	800
Operating Temperature:	−20 to +50°C
Power Voltage:	11.5V DC to 16.0V DC (13.8V DC standard)
Grounding:	Negative grounding
Antenna Impedance:	50Ω
DC Current:	Less than 0.5A in receive with no input signal Less than 3A in HI transmit (at 13.8V DC)
Dimensions:	161 mm (6-5/16″) wide 61 mm (2-3/8″) high 230 mm (9-1/16″) deep
Weight:	1.75 kg (3.85 lbs) Approx.

TRANSMITTER SECTION

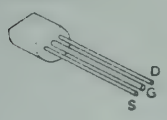
RF Output Power:	High: 10 watts (min.) Low: 1 watts approx. (adjustable to 10 watts)
Modulation:	Variable reactance direct shift
Max. Frequency Deviation:	±5 kHz
Spurious Radiation:	Less than −60 dB
Touch Tone Input Impedance:	600Ω
Microphone:	Dynamic microphone with PTT switch, 500Ω

RECEIVER SECTION

Circuitry:	Double superheterodyne
Intermediate Frequency:	1st: IF 10.7 MHz 2nd: IF 455 kHz
Sensitivity:	Less than 0.4 μV for 20 dB quieting (Less than 1 μV for 30 dB S/N)
Squelch Sensitivity:	Less than 0.25 μV
Pass Band Width:	More than 12 kHz at 6 dB down
Selectivity (2 Signal):	More than 76 dB at 30 kHz of adjacent channel
Image Rejection:	More than 70 dB
Spurious Interference:	More than 60 dB
Intermodulation:	More than 66 dB
Audio Output:	More than 1.5 watts across 8Ω load (10% distortion)

NOTE: The circuit and ratings may change without notice due to developments in technology.

2SK30A(GR)

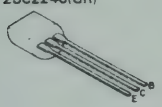


2SA496(Y)

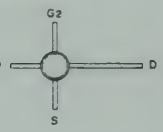
2SK19(GR)

2SC460(B)

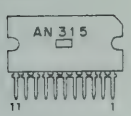
2SA1015(Y)
2SC1345(E)
2SC1815(Y)
2SC1923(O)
2SC1959(Y)
2SC2240(GR)



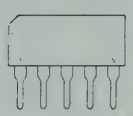
3SK74(L)



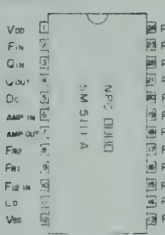
AN315



TA7060P

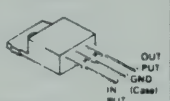


SM5111A



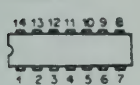
2SA1015(Y)
2SC1815(Y)

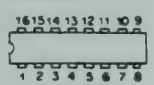
FS-7806M



TC5022BP
TC4019BP
TC4035BP

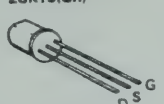
TC4081P





2SA496(Y)
2SC496(Y)

2SK19(GR)

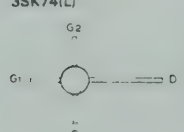


2SC460(B)

2SA1015(Y)
2SC1815(Y)
2SC1959(Y)

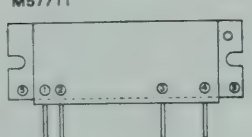
2SD235(Y)

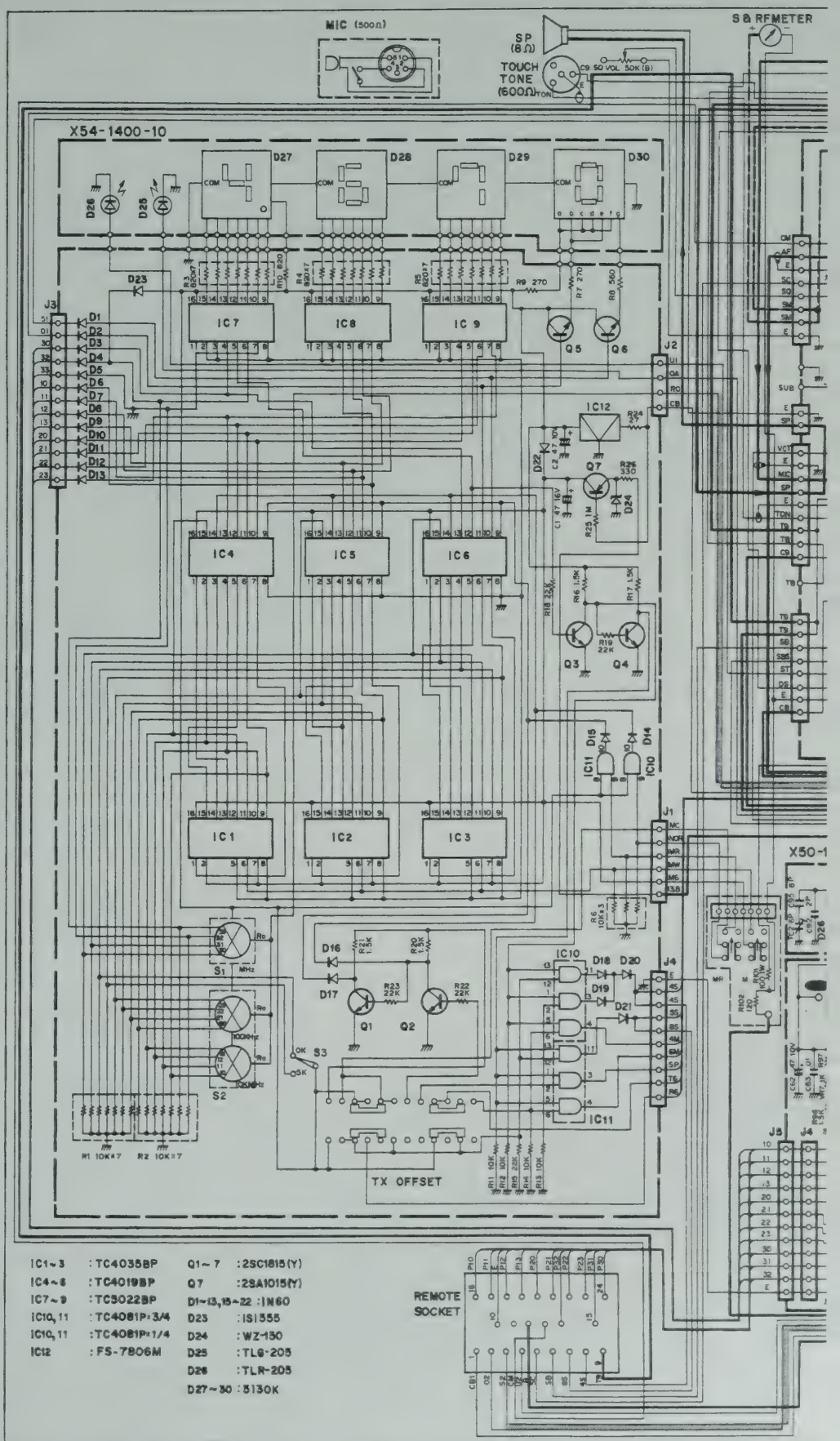
3SK74(L)



2SC2053

M57711





IC1~3	: TC4035BP	Q1~7	: 2SC1815(Y)
IC4~6	: TC4019BP	Q7	: 2SA1015(Y)
IC7~9	: TC5022BP	D1~13,15~22	: 1N60
IC10, 11	: TC4081P×3/4	D23	: IS1555
IC10, 11	: TC4081P×1/4	D24	: WZ-150
IC12	: FS-7806M	D25	: TLG-205
		D26	: TLR-205
		D27~30	: 5130K

① RFI, ② DRB, ③ FIB, ④ RFO.

SPECIFICATIONS

GENERAL

Semiconductors:	Transistors: 53 FETs: 9 ICs: 17 Diodes: 85
Frequency Range:	144.00 to 147.995 MHz
Frequency Synthesizer:	Digital control of phase locked VCO
Synthesizer Stability:	Less than ±750 Hz at 25°C
Mode:	FM
No. of Channels:	800
Operating Temperature:	−20 to +50°C
Power Voltage:	11.5V DC to 16.0V DC (13.8V DC standard)
Grounding:	Negative grounding
Antenna Impedance:	50Ω
DC Current:	Less than 0.5A in receive with no input signal Less than 3A in HI transmit (at 13.8V DC)
Dimensions:	161 mm (6-5/16″) wide 61 mm (2-3/8″) high 230 mm (9-1/16″) deep
Weight:	1.75 kg (3.85 lbs) Approx.

TRANSMITTER SECTION

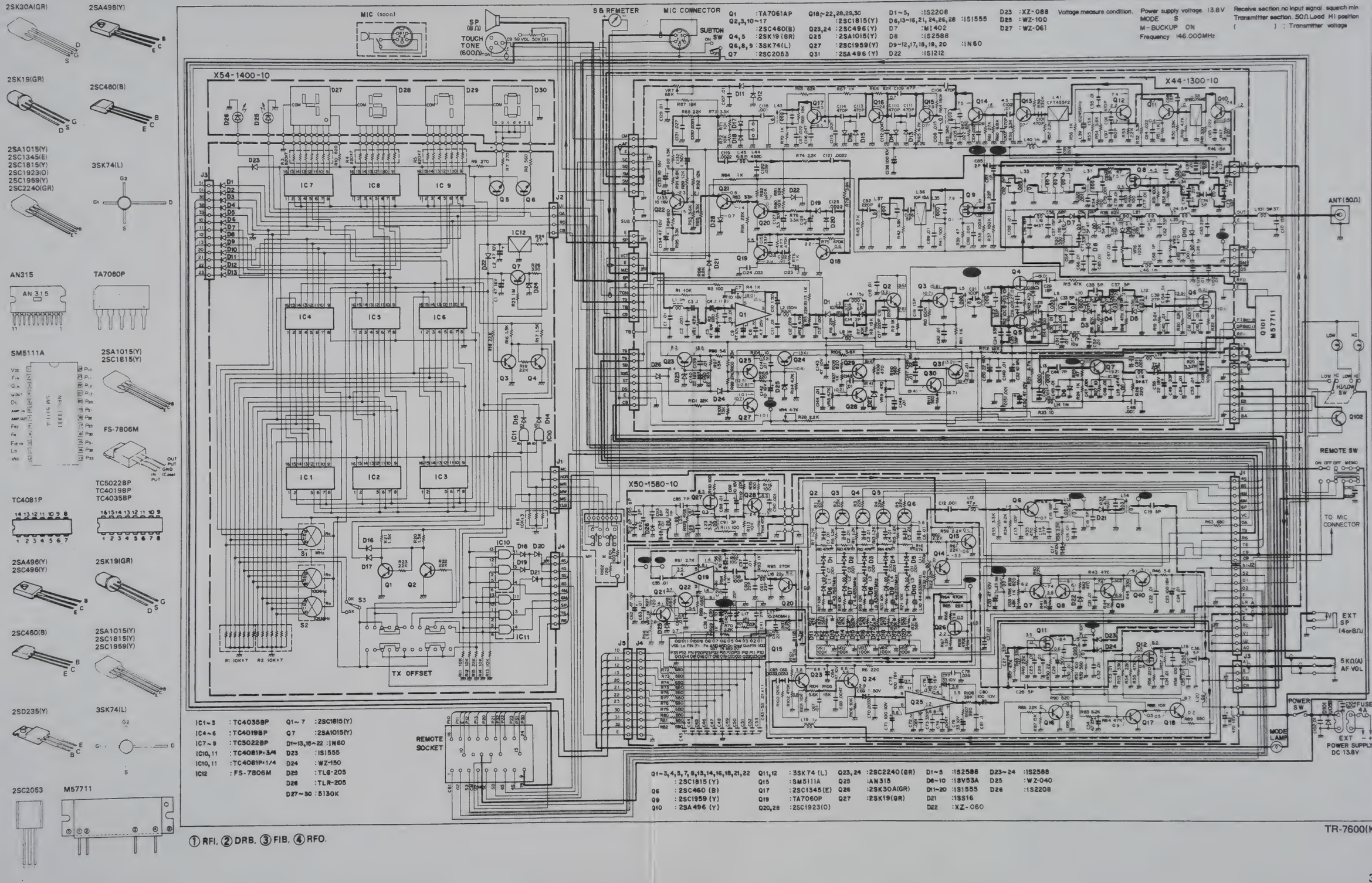
RF Output Power:	High: 10 watts (min.) Low: 1 watts approx. (adjustable to 10 watts)
Modulation:	Variable reactance direct shift
Max. Frequency Deviation:	±5 kHz
Spurious Radiation:	Less than −60 dB
Touch Tone Input Impedance:	600Ω
Microphone:	Dynamic microphone with PTT switch, 500Ω

RECEIVER SECTION

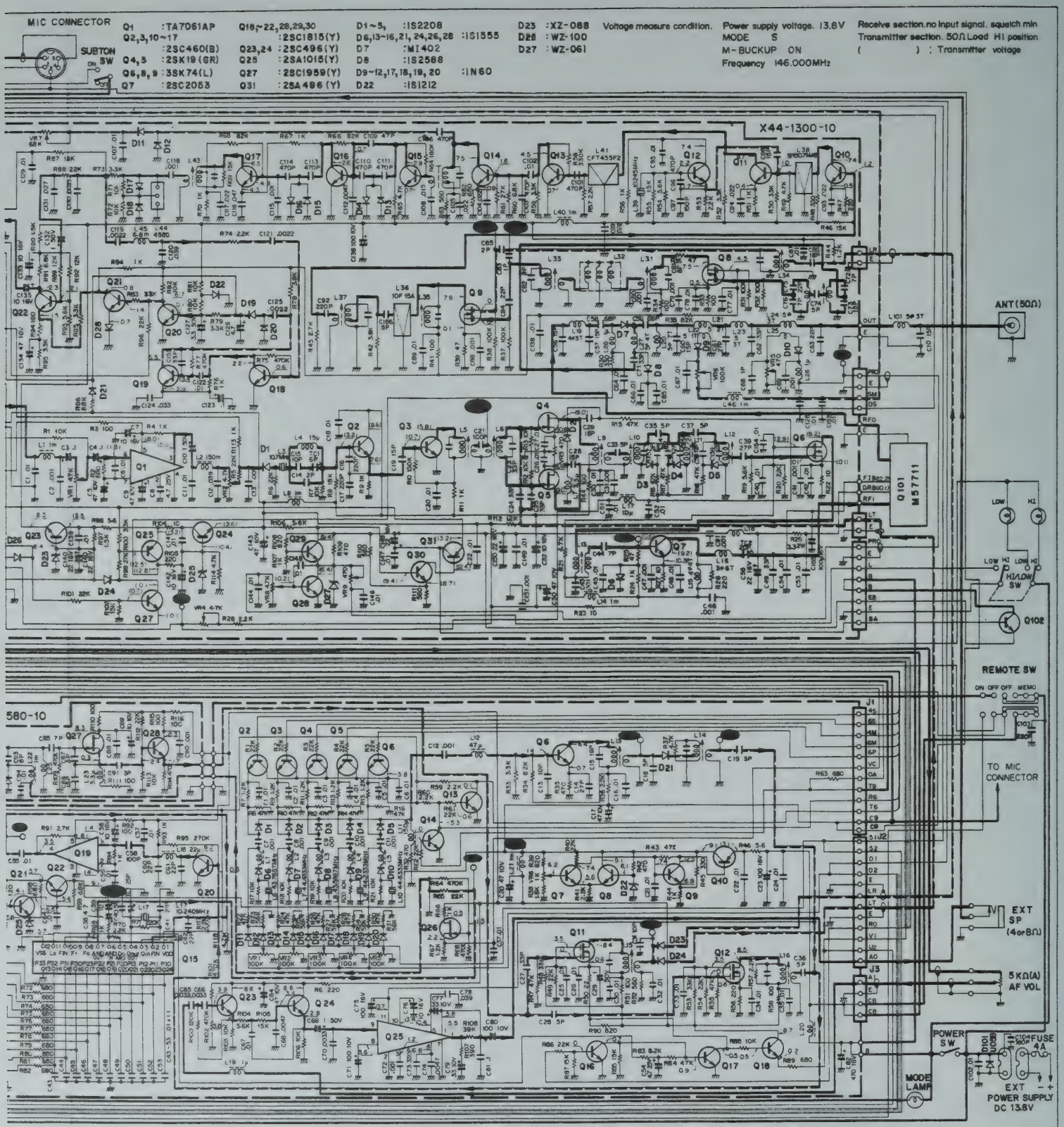
Circuitry:	Double superheterodyne
Intermediate Frequency:	1st: IF 10.7 MHz 2nd: IF 455 kHz
Sensitivity:	Less than 0.4 μV for 20 dB quieting (Less than 1 μV for 30 dB S/N)
Squelch Sensitivity:	Less than 0.25 μV
Pass Band Width:	More than 12 kHz at 6 dB down
Selectivity (2 Signal):	More than 76 dB at 30 kHz of adjacent channel
Image Rejection:	More than 70 dB
Spurious Interference:	More than 60 dB
Intermodulation:	More than 66 dB
Audio Output:	More than 1.5 watts across 8Ω load (10% distortion)

NOTE: The circuit and ratings may change without notice due to developments in technology.

SCHEMATIC DIAGRAM



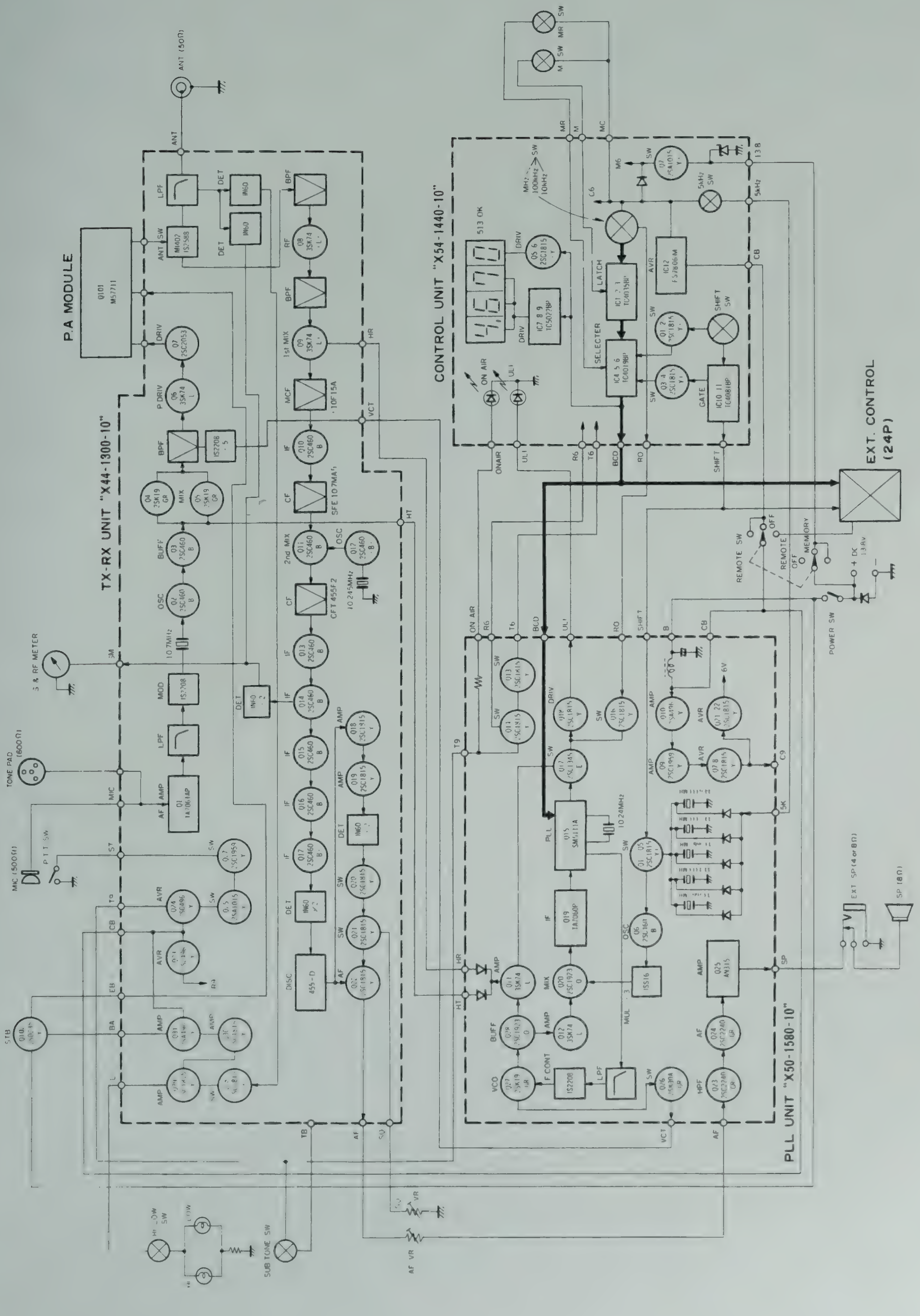
ATIC DIAGRAM



D1~3,4,5,7,8,13,14,16,18,21,22 : 2SC1815(Y)
D6 : 2SC460(B)
D9 : 2SC1959(Y)
D10 : 2SA496(Y)
Q11,12 : 3SK74(L)
Q15 : SM5111A
Q17 : 2SC1345(E)
Q19 : TA7060P
Q20,28 : 2SC1923(O)
Q23,24 : 2SC2240(GR)
Q25 : AN315
Q26 : 2SK30A(GR)
Q27 : 2SK19(GR)
D1~5 : 1S2588
D6~10 : 1SV53A
D11 : 1SS16
D22 : XZ-060
D23~24 : 1S2588
D25 : WZ-040
D26 : 1S2208

TR-7600(K)

BLOCK DIAGRAM



A product of
TRIO-KENWOOD CORPORATION
6-17, 3-chome, Aobadai, Meguro-ku, Tokyo 153, Japan

TRIO-KENWOOD COMMUNICATIONS, INC.
1111, West Walnut Street Compton California 90220 U S A
TRIO-KENWOOD COMMUNICATIONS, GmbH
D 6374 Steinbach TS Industriestrasse 8A West Germany
TRIO-KENWOOD(AUSTRALIA)PTY. LTD.
30 Whiting Street Artarmon Sydney N S W Australia 2064

1978-12 PRINTED IN JAPAN B51-0865-00 1000 (K)(W)(T) (G)

KENWOOD

SERVICE MANUAL

TR-7600

2m FM TRANSCEIVER

INDUCTION/CONTENTS

INTRODUCTION

Your KENWOOD Model TR-7600 is an advanced 2-meter transceiver for amateur mobile, and optional fixed station operation.

The TR-7600 features:

- ☆ Memory channel (simplex and repeater mode).
- ☆ Memory TX and ±600 kHz repeater TX for repeater operation.
- ☆ 800 channel PLL circuit.
- ☆ Digital frequency display.
- ☆ Dual concentic frequency selector switches.
- ☆ PLL UNLOCK and ON AIR indicators.
- ☆ Subaudible ON/OFF switch (Encoder user installed).
- ☆ Powered tone pad connector with 9V DC on one pin.
- ☆ Pin Mic connector with 9V DC on one pin.
- ☆ TX HI-LOW (Power) switch.

CONTENTS

GENERAL/CIRCUIT DESCRIPTION

GENERAL

The TR-7600 is a 10W, multi-channel (800 channels) FM transceiver covering 144 ~ 147.995 MHz. It features a built-in repeater shift circuit and memory circuit, and provision for connection of an option remote controller for operation with a micro-computer.

PLL CIRCUIT

The TR-7600 employs PLL circuit composed of IC SM5111A for programmable counter, reference oscillator, frequency divider and phase detector. Setting of frequency division ratio, frequency memory and remote indication functions are all controlled by BCD codes.

PLL CIRCUIT BLOCK DIAGRAM

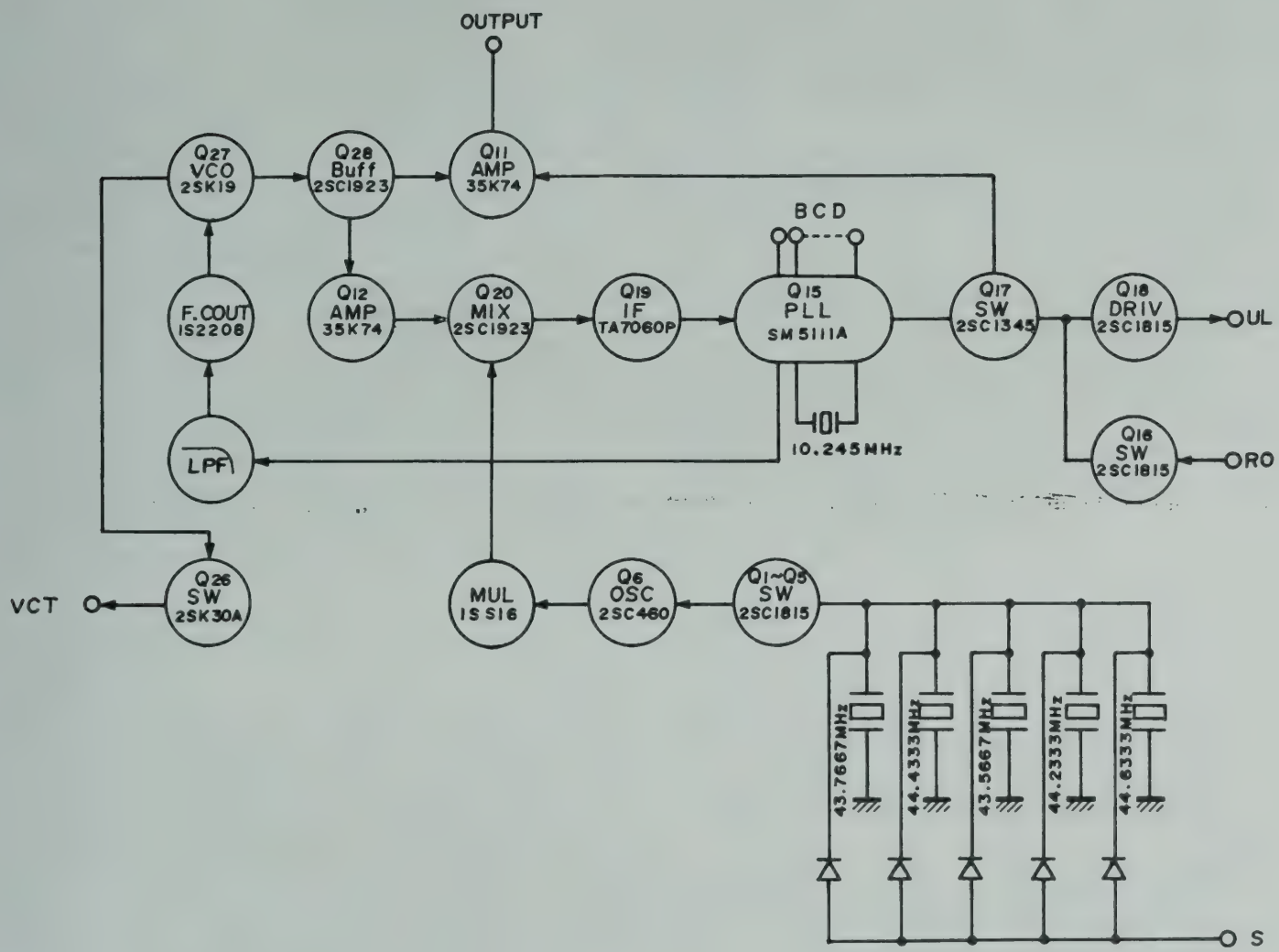


Fig. 1 PLL Circuit

CIRCUIT DESCRIPTION

1. Phase Locked Loop

The 130 MHz signal from Q27 passes through the buffer circuit Q28 and is then divided into a synthesizer output and a loop output by Q11 and Q12 respectively. The output from Q12 is mixed with the local oscillator output, trippled by Q6 and 1SS16, by Q20 to obtain IF frequency. The IF output is amplified by Q19 and is fed to Q15 where the output is frequency divided in the ratio specified by BCD code to compare it with the 10 kHz reference frequency (1/1024 of 10.240 MHz).

The DC output thus obtained passes through the low-pass filter to control the VCO vari-cap 1S2208. The output from Q26 controls the transmit frequency bandwidth. When the signal is unlocked, the output is shut off by Q17 which is indicated by Q18. Q16 is used to shut off the output when the rotary switch is between channel setting positions.

Rx Tx Freq.	Simplex Output	Division	Osc Xtal Freq.	IF Freq.
144.00 MHz	133.3 MHz	200	43.7667 MHz	2 MHz
145.00 MHz	134.3 MHz	300	43.7667 MHz	3 MHz
145.99 MHz	135.29 MHz	399	43.7667 MHz	3.99 MHz
146.00 MHz	135.3 MHz	200	44.4333 MHz	2 MHz
147.00 MHz	136.3 MHz	300	44.4333 MHz	3 MHz
147.99 MHz	137.29 MHz	399	44.4333 MHz	3.99 MHz

Table 1 Division and Frequency

2. +5 kHz Circuit

In the PLL circuit, the reference frequency is controlled in 10 kHz steps. The +5 kHz signal is controlled by varying the local oscillator crystal frequency with the vari-cap, so the frequency division remains unchanged even when the +5 kHz circuit is operated.

The memory circuit also includes the same bit and functions even when the +5 kHz circuit is operating.

3. Shift Circuit

Transmit frequencies can be shifted by changing the local oscillator crystal, as shown below.

144 and 145 MHz bands:

[−] shift	43.5667 MHz
[S]	43.7667 MHz

The [+] shift is not available for 144 and 145 MHz bands.

The [S] is obtained at the [+] position.

146 and 147 MHz Bands:

[−] shift	44.2333 MHz
[+] shift	44.6333 MHz
[S]	44.4333 MHz

4. Memory Shift Circuit

The memory shift circuit (MT) is a circuit to shift the memory input frequency during transmission. The function is the same as in [S].

CONTROL UNIT

Frequency settings are accomplished by the MHz, 100 kHz and 10 kHz rotary switches. The relationship between the frequency and frequency division is shown below.

Frequency	Frequency division
144.000 MHz	200
145.000 MHz	300
145.990 MHz	399
146.000 MHz	200
147.000 MHz	300
147.990 MHz	399

The local oscillator frequency of kHz order can be shifted by the switch. The frequency division set by the rotary switch is stored in the latch IC's 1, 2 and 3 by pressing the memory input switch. The output from the latch circuit is fed through IC's 4, 5 and 6 in the selector circuit to the PLL circuit by pressing the memory call switch. When this switch is not pressed, the output is directly fed to the PLL circuit. Memory function is effected by latching each switch. The information from each switch is stored by pressing the memory switch. The stored information remains the same unless the memory switch is pressed once again. Selection of memory output and rotary output is accomplished by the selector circuit. A latched output is obtained by pressing the memory output switch.

The signal to the PLL circuit passes through the LED driver circuit and is digitally indicated by LED (orange).

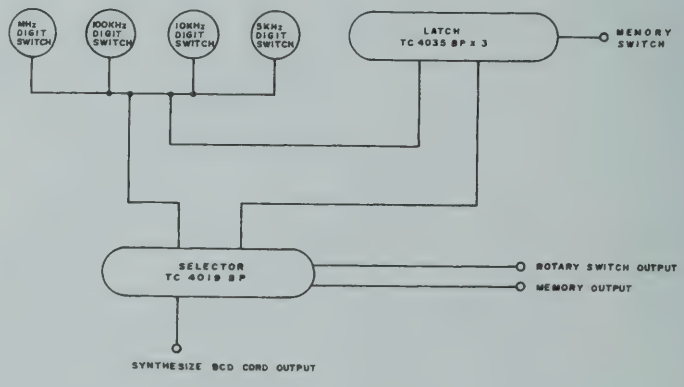


Fig. 2 Block Diagram of Frequency Memory Circuit

CIRCUIT DESCRIPTION

TRANSMITTER UNIT

The microphone signal passes through the limiter amplifier and is FM modulated by the 10.7 MHz oscillator. The signal is mixed with the local oscillator signal to obtain 144 ~ 146 MHz signal. The B.P.F. is of a variable type, providing excellent characteristics with respect to power and spurious even at the shift time because of the use of VCO voltage. The power stage uses the power module M5711 manufactured by the Mitsubishi Electric Co., to provide higher reliability.

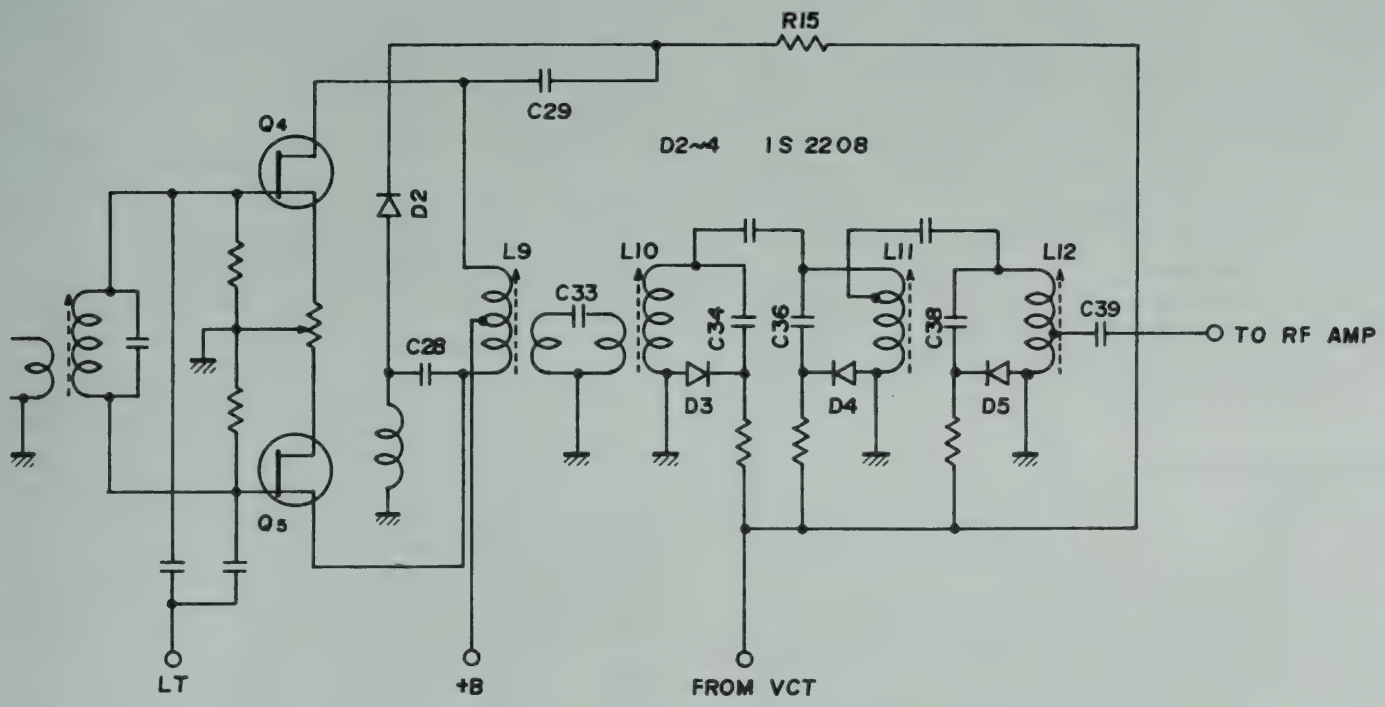


Fig. 3 Variable Band Width Control Circuit (for Transmission)

RECEIVER UNIT

The signal from the transmit/receive matching circuit passes through the diode switch and is fed to the 2-stage antenna tuning circuit, 3-stage merical tuning circuit and RF amplifier of MOS FET. This signal is further fed to the mixer circuit MOS FET where it is converted into 10.7 MHz signal. The signal thus converted passes through the 2-stage filter and is fed to the 2nd mixer where it is converted into 455 kHz signal. The 2nd IF signal from the 455 kHz ceramic filter passes through the limiter circuit where it is converted into AF signal by the ceramic discriminator. This signal is amplified by the audio power amplifier to drive the speaker.

The receiver unit includes a noise amplification type squelch circuit. This circuit picks up the noise component in the squelch signal from the discriminator which is amplified and rectified to control the 1st stage AF amplifier.

The characteristic of the discriminator is opposite that of conventional ones to permit connection of a remote controller.

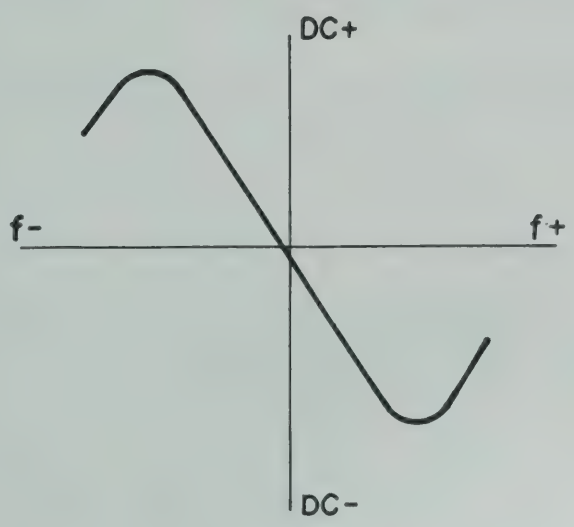


Fig. 4 Discriminator Characteristics

SM5111A

Electrostatic Breakdown Protection

This product has a built-in input protection circuit to prevent a gate breakdown due to static electricity.

In order to protect the input circuit from damage due to a large static electricity or voltage in excess of the limit permissible to the circuit, the following points should be observed:

1. When the product is not in use, keep all the terminals in contact with insulating material (this is done at the factory prior to shipment).
2. Soldering iron, testing instrument and other tools should be earthed while in use.
3. Do not insert or remove IC from the socket without turning off the power.
4. Do not apply signal voltage to the input terminal when the power is OFF.
5. Do not apply a voltage exceeding the power voltage to the input terminal.

OPERATING SYSTEM

This product has been developed as C-MOS LSI used for PLL circuit. As shown in the block diagram in Fig. 1, it consists of OSC: reference oscillator circuit, DIVIDER: reference frequency dividing circuit, PC: programmable counter, PD: phase comparator, and INV: inverter. A high accuracy feedback type crystal oscillator circuit can be formed by adding a crystal oscillating element, resistor and capacitor between the QIN and QOUT terminals of the reference oscillator circuit. This also permits an external signal to be fed to the QIN terminal.

The oscillator output is applied to the reference frequency dividing circuit where it is divided into the desired frequencies of fr1 (1/2028) and fr2 (1/1024) which are the reference signals of the digital type phase comparator on the next stage.

The comparison signal (frequency f1) fed to the input terminal FIN of the AMP is amplified and wave shaped, then fed to the input of the programmable counter. The frequency "f1" is frequency converted (fpc) through the program terminals P01 ... P33 (for example, when P01 ... P33 = 1, the programmable counter output is 1/999), and is fed to the phase comparator where the reference signal is compared with the comparison signal in phase so that a pulse signal, shown below, proportional to the phase difference in two signals is fed to the output terminal DO.

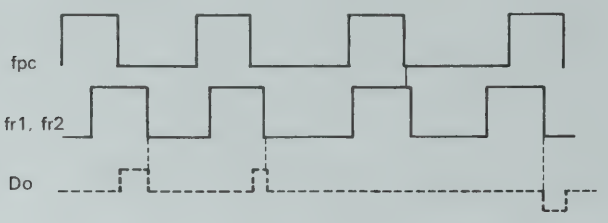


Fig. 5

The table below shows the maximum limits of operating conditions and environmental conditions. If any of these values exceeds the given limits, it can be a cause of damage to the product or deterioration of quality.

Item	Symbol	Rating	Unit
Power Supply Voltage	DDV -Vss	$-0.3 \sim +7.5$	V
Input Voltage	V_{IN}	$V_{SS} \leqq V_{IN} \leqq V_{DD}$	V
Operating Temperature	T_A	$-30 \sim +70$	°C
Storage Temperature	T_{STG}	$-40 \sim +125$	°C
Power Consumption	P_D	250	mW
Soldering Temperature		260	°C
Soldering Time		5	sec

Table 2 SM5111A Absolute Maximum Ratings

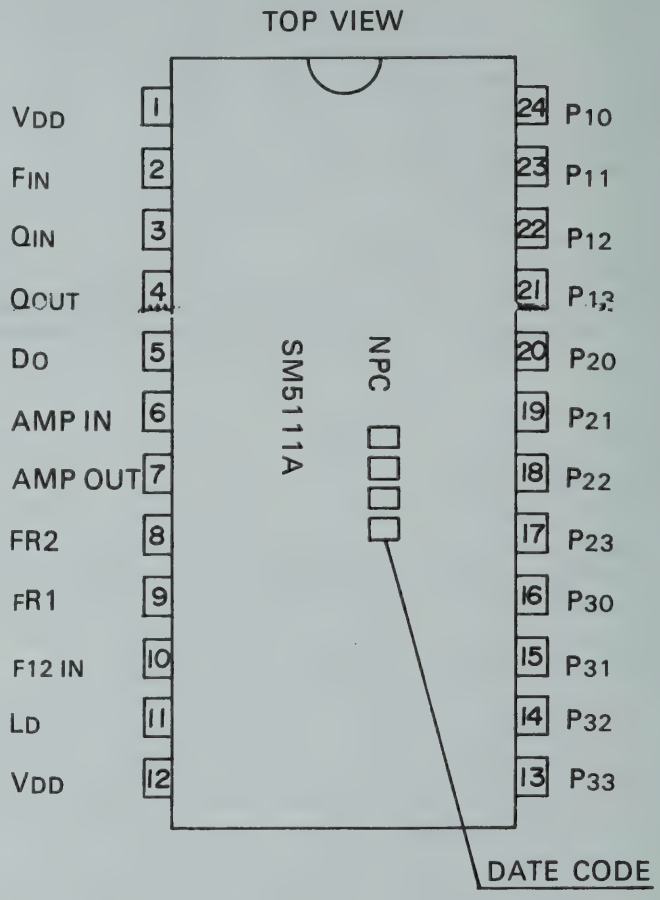


Fig. 6 SM5111A Pin Arrangement

DATA

3SK74

SPECIFICATIONS

Application	VHF RF Amplifier (Mixer)	
Construction	N-Channel • MOS FET (Dual Gate)	
Drain • Source Voltage	V_{DSX}	20V
Gate 1 • Source Voltage	V_{G1S}	±10V
Gate 2 • Source Voltage	V_{G2S}	±10V
Drain Current	I_D	25 mA
Allowable Loss	P_T	200 mW
Channel Temperature	T_{CH}	125°C
Storage Temperature	T_{STG}	−5.5 ~ +125°C

Maximum Specifications

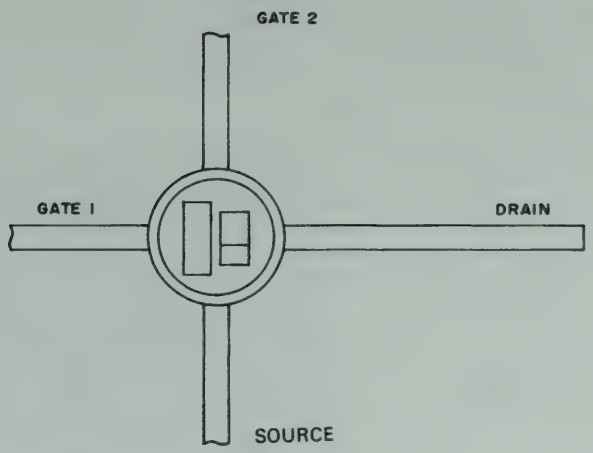


Fig. 7 3SK74 Outlines

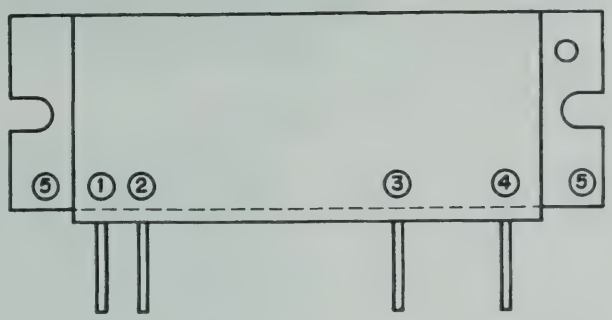
TEST CONDITION

Item	Code	Condition
Drain • Source Voltage	V_{DSX}	V_{G1S} = −3V, V_{G2S} = 3V, I_D = 500nA
Drain Current	I_{DSS}	V_{DS} = 6V, V_{G1S} = 0, V_{G2S} = 3V
Cut-Off Voltage (Gate 1)	V_{G1S}	V_{DS} = 6V, V_{G2S} = 0, I_D = 500nA
Cut-Off Voltage (Gate 2)	V_{G2S}	V_{DS} = 6V, V_{G1S} = 0, I_D = 500nA
Gate Leak Current (Gate 1)	I_{G1SS}	V_{DS} = 0, V_{G1S} = ±10V, V_{G2S} = 0
Gate Leak Current (Gate 2)	I_{G2SS}	V_{DS} = 0, V_{G1S} = 0, V_{G2S} = ±10V
Small Signal Transfer Admittance	$\|y_{fs}\|$	V_{DS} = 6V, V_{G2S} = 3V, I_D = 10mA, f = 1.0 kHz
Small Signal Input Capacity	C_{iss}	V_{DS} = 6V, V_{G2S} = 3V, I_D = 10mA, f = 1.0 MHz
Small Signal Output Capacity	C_{oss}	V_{DS} = 6V, V_{G2S} = 3V, I_D = 10mA, f = 1.0 MHz
Small Signal Feedback Capacity	C_{rss}	V_{DS} = 6V, V_{G2S} = 3V, I_D = 10mA, f = 1.0 MHz
Output Power Gain	G_P	V_{DD} = 10V, I_D = 10mA, f = 200 MHz
Noise Figure	NF	V_{DD} = 10V, I_D = 10mA, f = 200 MHz

Maximum Rating of M57711

(TA = 25°C, unless otherwise noted)

Item	Symbol	Condition	Value	Unit
Operating Voltage	V_{CC}		17	V
DC Current	I_{CC}		5	A
Operating Temperature	$T_{C(OP)}$		−30 ~ +110	°C
Storage	T_{STG}		−30 ~ +110	°C



1. Input Terminal (RFI)
2. Power Supply of Drive Stage (DRB)
3. Power Supply of Output Stage (FIB)
4. Output Terminal (RFO)
5. GND

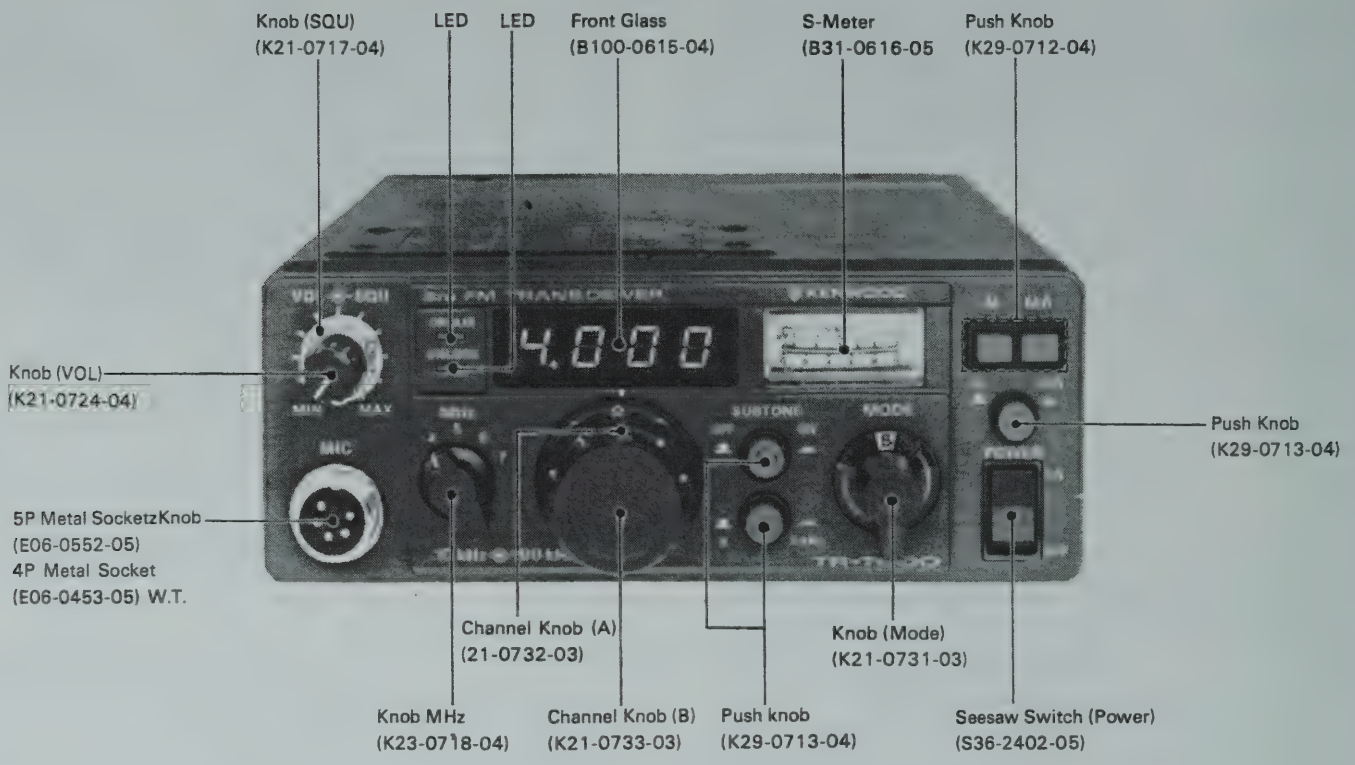
Fig. 8 M57711 Outlines

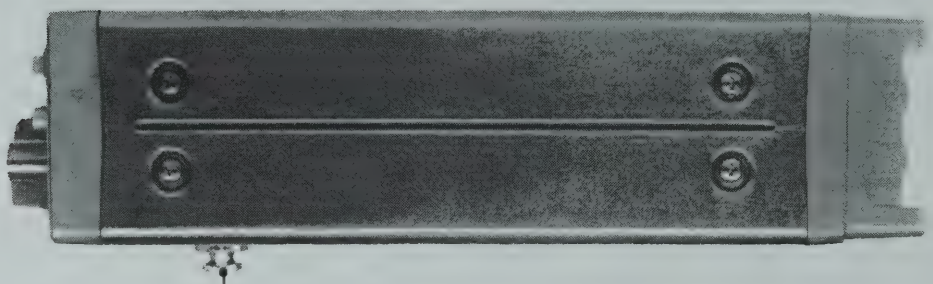
Electrical Characteristic of M57711

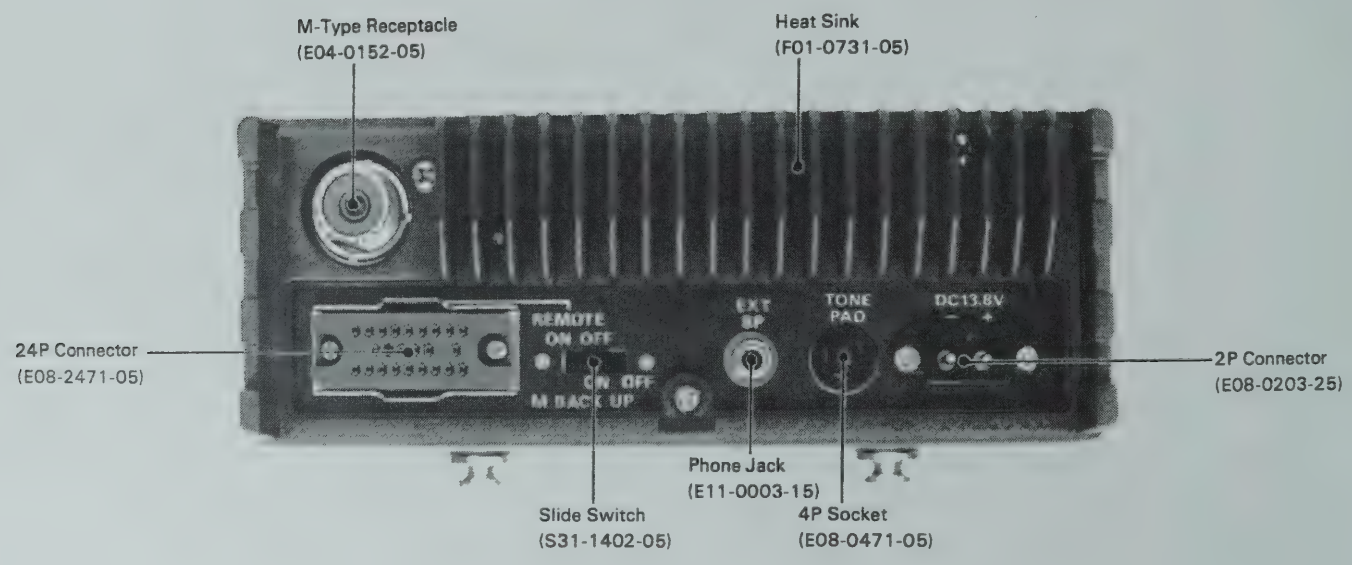
(TA = 25°C unless otherwise noted)

Item	Symbol	Condition	Value			Unit
			Min.	Std.	Max.	
Output Power	P_O	f = 144 ~ 148 MHz, V_{CC} = 12V, Pin = 0.15W, Z_G = Z_L = 50Ω	14	16		W
Total Efficiency	S_T	f = 144 ~ 148 MHz, V_{CC} = 12V, Pin = 0.15W, Z_G = Z_L = 50Ω	53	58		%
2nd Harmonic Radiation		f = 144 ~ 148 MHz, V_{CC} = 12V, Pin = 0.15W, Z_G = Z_L = 50Ω			−25	dB
More than 3rd Harmonic Radiation		f = 144 ~ 148 MHz, V_{CC} = 12V, Pin = 0.15W, Z_G = Z_L = 50Ω			−35	dB
Input VSWR	P_{IN}	f = 144 ~ 148 MHz, V_{CC} = 12V, Pin = 0.15W, Z_G = Z_L = 50Ω		2.5	2.8	
Output VSWR	P_{OUT}	f = 144 ~ 148 MHz, V_{CC} = 12V, Pin = 0.15W, Z_G = Z_L = 50Ω		1.3	1.5	
Impedance		Note	∞ : 1			

PANEL CONTROLS

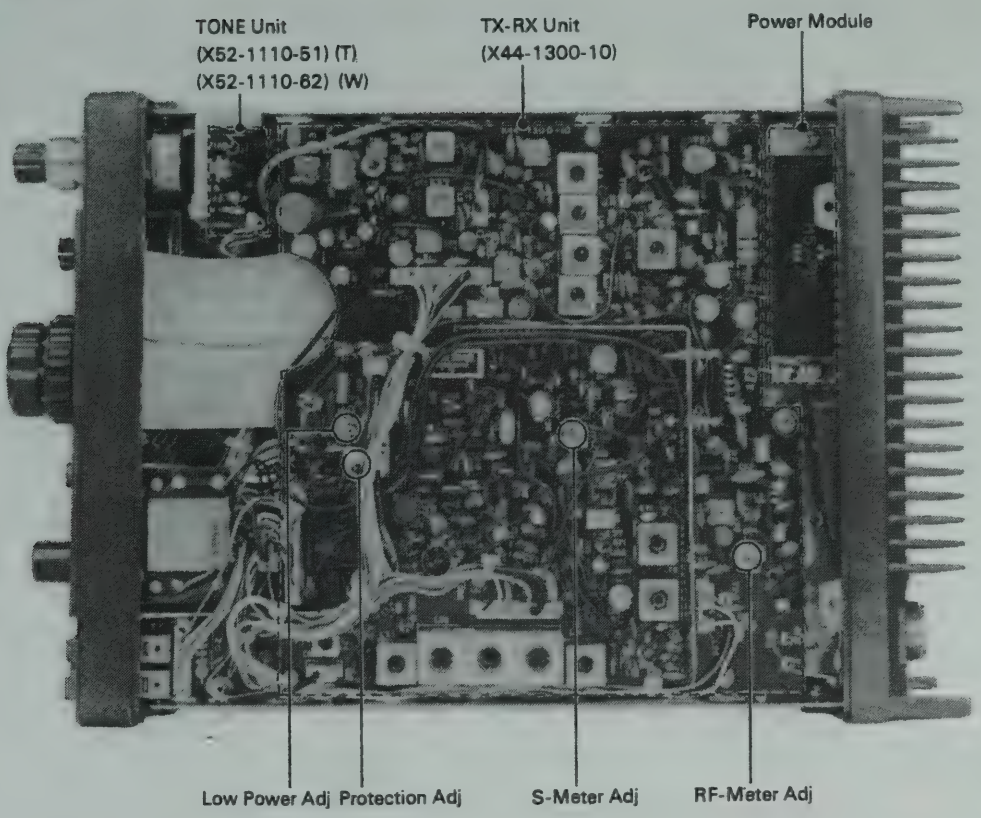




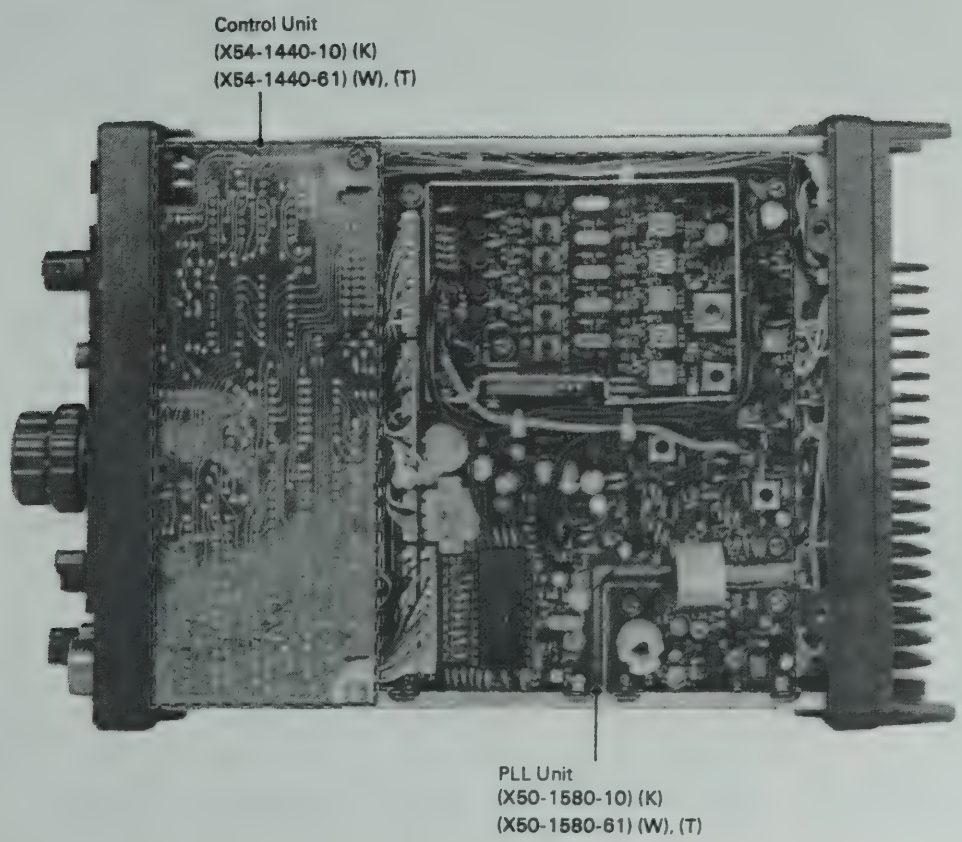


PARTS ALIGNMENT

VIEWED FROM TOP

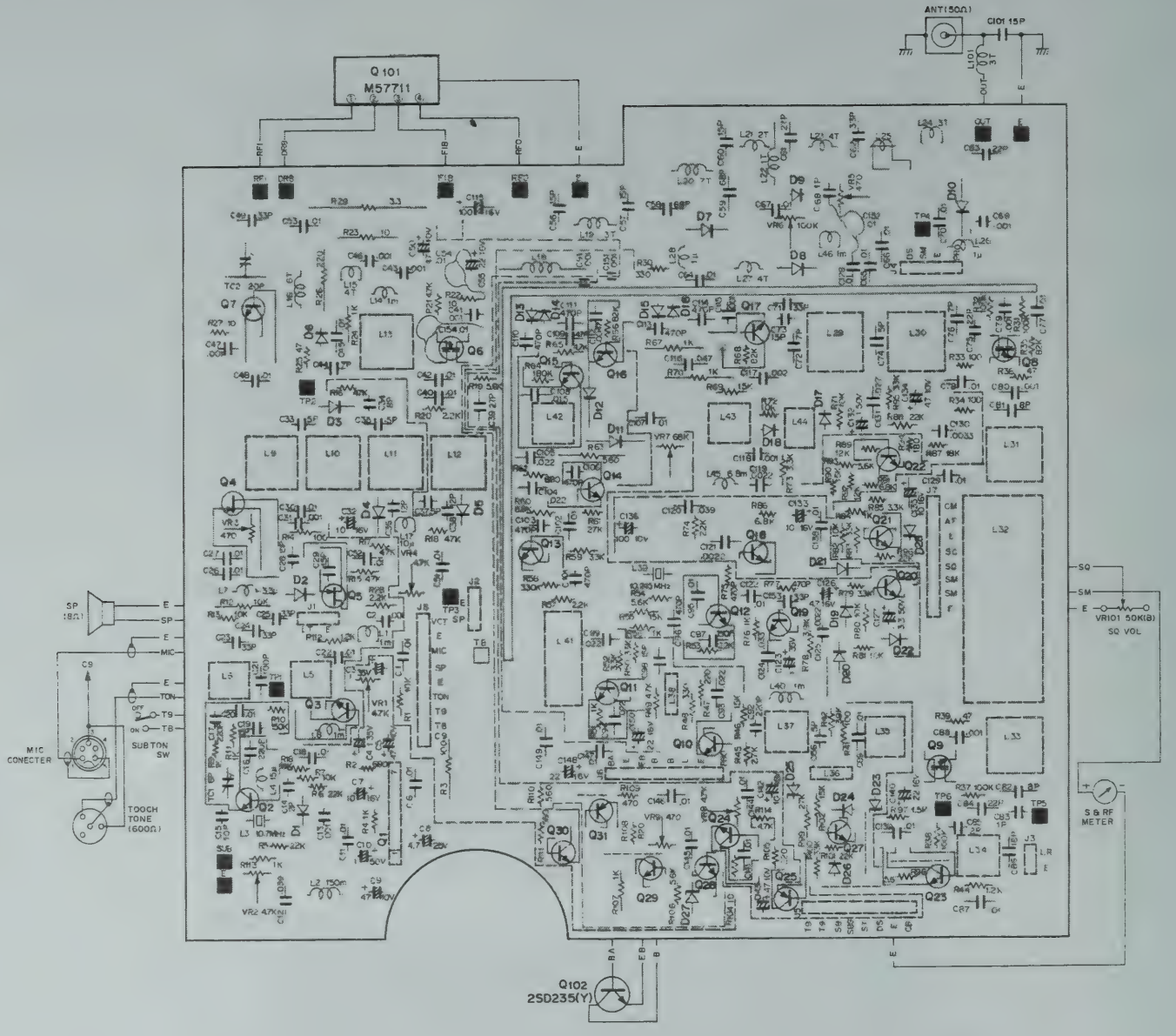


VIEWED FROM BOTTOM



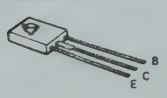
PC BOARD

■ TX-RX UNIT (X44-1300-10)



Q1	:TA7061AP	Q18~22,28,29,30		D1~5,	:IS2208	D23	:XZ-088
Q2,3,10~17			:2SC1815(Y)	D6,13~16,21,24,26,28	:IS1555	D25	:WZ-100
	:2SC460(B)	Q23,24	:2SC496(Y)	D7	:MI402	D27	:WZ-061
Q4,5	:2SK19(GR)	Q25	:2SA1015(Y)	D8	:IS2588		
Q6,8,9	:3SK74(L)	Q27	:2SC1959(Y)	D9~12,17,18,19,20	:IN60		
Q7	:2SC2053	Q31	:2SA496(Y)	D22	:IS1212		

2SA496(Y)
2SC496(Y)

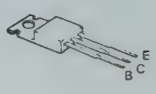


2SK19(GR)

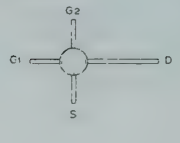
2SC458(B)
2SC460(B)

2SA1015(Y)
2SC1815(Y)
2SC1959(Y)

2SD235(Y)



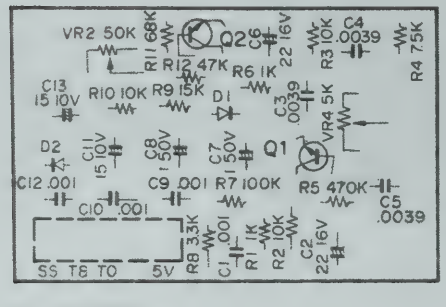
3SK74(L)



2SC2053

M57711

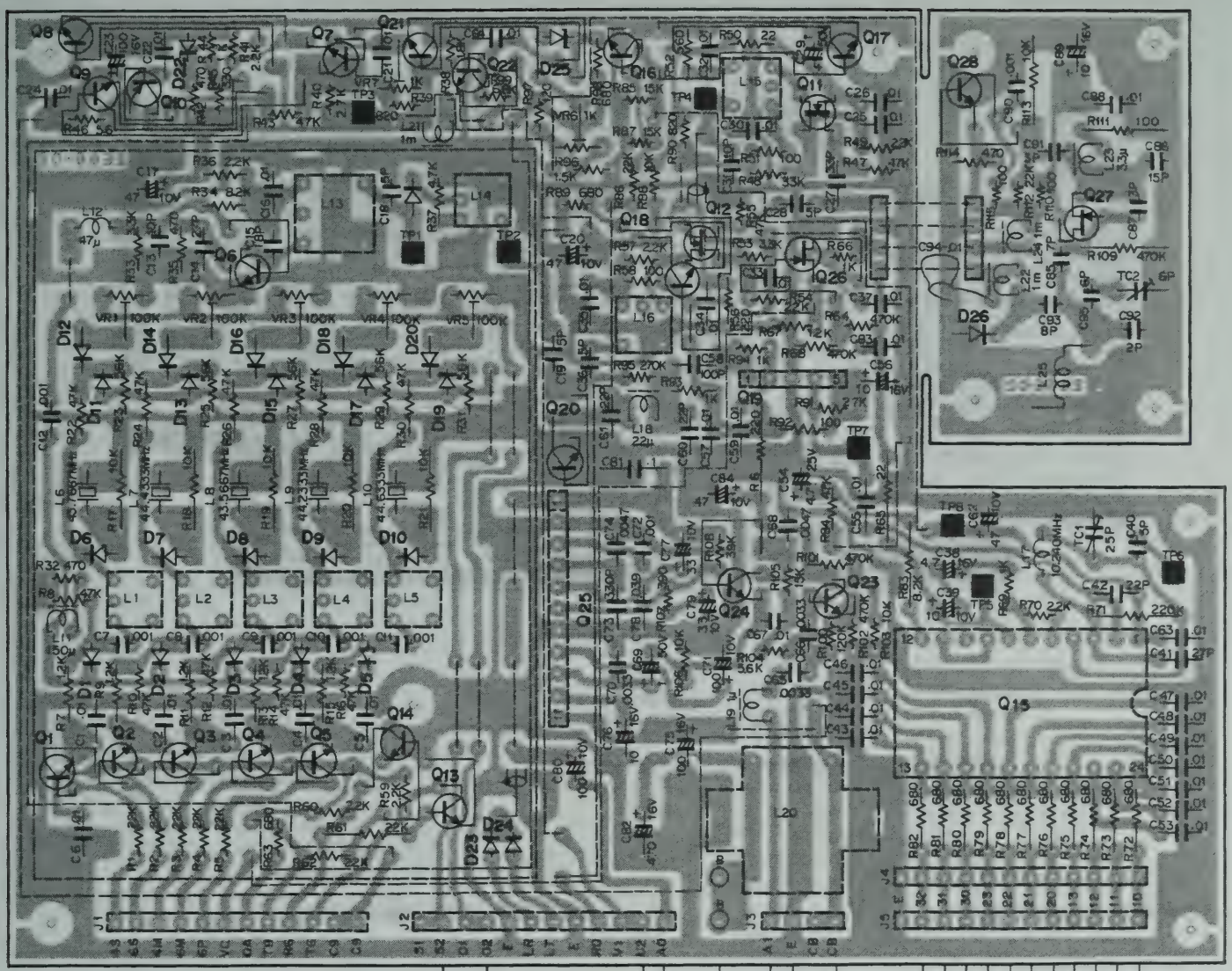
TONE UNIT (X52-1110-51) T TYPE

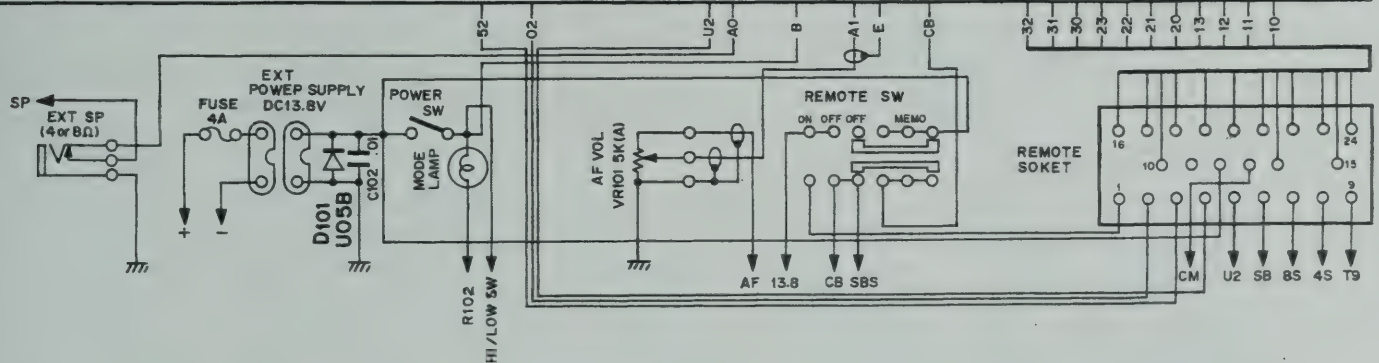


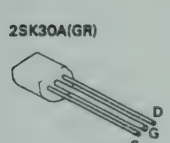
Q1,2 : 2SC458 (B)

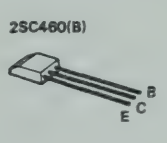
PC BOARD

■ PLL UNIT (X50-1580-10)

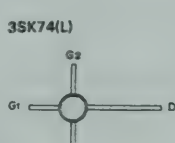


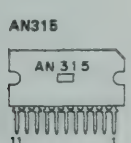


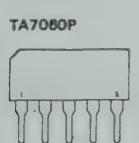


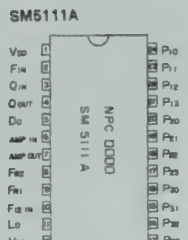


2SA1015(Y)
2SC1345(E)
2SC1815(Y)
2SC1923(O)
2SC1959(Y)
2SC2240(GR)







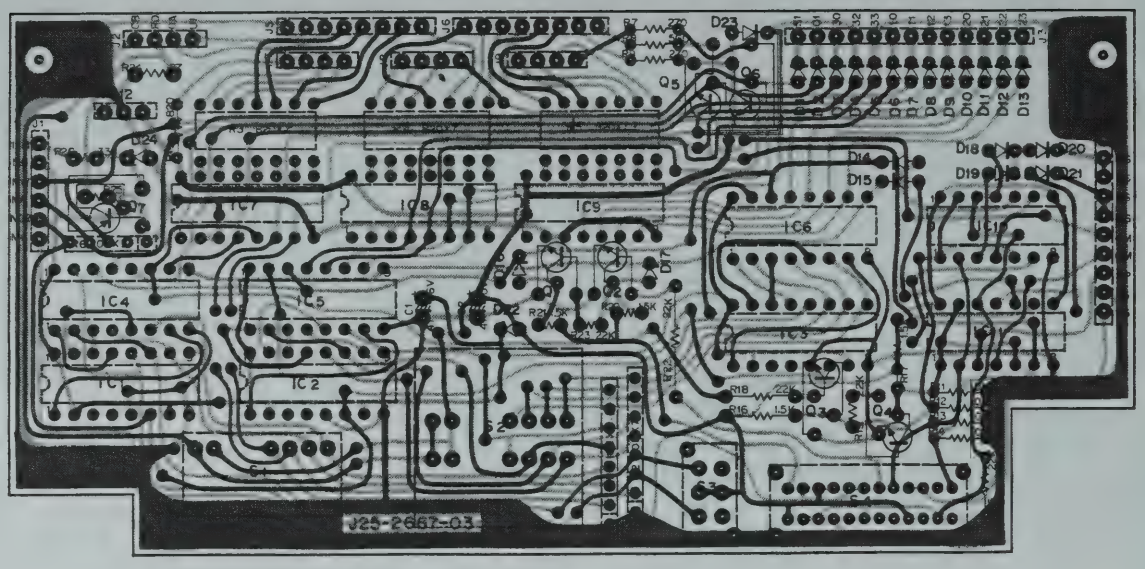


Q1~5,7,9,13,14,16,18,21,22	: 2SC1815(Y)
Q6	: 2SC460(B)
Q8	: 2SC1959(Y)
Q10	: 2SA496(Y)
Q11,12	: 3SK74(L)
Q15	: SM5111A
Q17	: 2SC1345(E)
Q19	: TA7060P
Q20,28	: 2SC1923(O)
Q23,24	: 2SC2240(GR)
Q25	: AN315
Q26	: 2SK30A(GR)
Q27	: 2SK19(GR)
D1~8	: 1S2588
D9~10	: 1SV53A
D11~20	: 1S1555
D21	: 1SS16
D22	: XZ-060
D23~24	: 1S2588
D25	: WZ-040
D26	: 1S2206

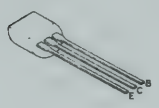
PC BOARD

■ CONTROL UNIT (X54-1380-00)

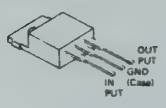
J25-2668-04



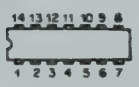
2SA1015(Y)
2SC1815(Y)



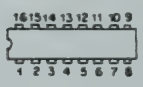
FS-7806M



TC4081P

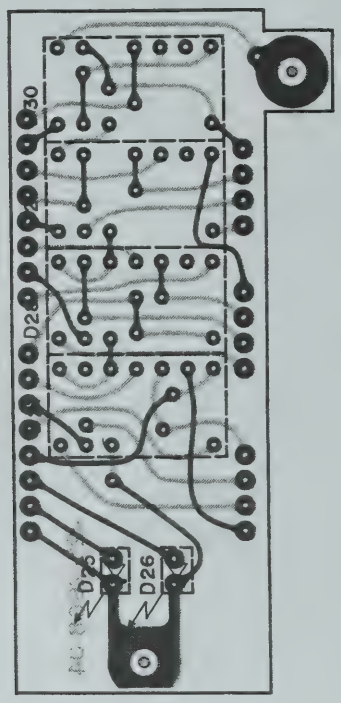


TC5022BP
TC4019BP
TC4035BP

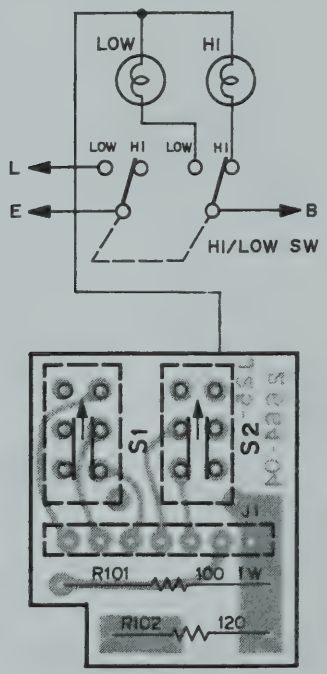


IC1~3	:TC4035BP	Q1~7	:2SC1815(Y)
IC4~6	:TC4019BP	Q7	:2SA1015(Y)
IC7~9	:TC5022BP	D1~13,15~22	:1N60
IC10,11	:TC4081P-3/4	D23	:1S1555
IC10,11	:TC4081P-1/4	D24	:WZ-150
IC12	:FS-7806M	D25	:TLS-205
		D26	:TLR-205
		D27~30	:5130K

J25-2668-04 (Indicator)



J25-2664-04 (Switch)



PARTS LIST

NOTE:
Except special types (example: cement, metal film, etc.) resistors are not detailed in the PARTS LIST. Regarding value, refer to the schematic diagram or the PC board illustration. Resistors not otherwise detailed are carbon type (1/4 or 1/8W).
Order carbon resistors according to the following example:
A carbon resistor's part number is RD14BY 2E222J.

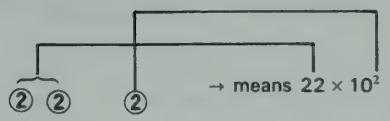
1. Type of the carbon resistor

RD14BY

RD14CY

2. Wattage
   1/4W → 2E
   1/8W → 2B

3. Resistance value



Significant figure Multiplier
Example:
221 → 220Ω
222 → 2.2kΩ
223 → 22kΩ
224 → 220kΩ
225 → 2.2MΩ

GENERAL

☆ : New parts

Ref. No.	Parts No.	Description		Remarks
		CAPACITORS		
C101	CC45SL2H150D	Ceramic 15pF ±0.5pF		
C102	CK45F1J103Z	Ceramic 0.01μF +80,−20%		
C103	CK45B1H221K	Ceramic 220pF ±10%		
C104	CC45SL1H181J	Ceramic 180pF ±5%		
		SEMICONDUCTOR		
Q101	V30-1030-36	Power module M57711		☆
Q102	V04-0046-05	Transistor 2SD235 (Y)		
D101	V11-0270-05	Diode V05B		
		COIL		
L101	L34-0821-05	(No care) 5φ3T		☆
		POTENTIOMETER		
VR101	R19-9403-05	15kΩ (A) 50k (B)		
		MISCELLANEOUS		
—	A01-0734-13	Case (A)		☆
—	A01-0735-03	Case (B)		☆
—	A20-2334-05	Die casting panel (Front)	(K)	☆
—	A20-2339-03	Die casting panel (Front)	(W)	☆
—	A20-2340-03	Die casting panel (Front)	(T)	☆
—	B05-0707-04	Speaker grill cloth		☆
—	B10-0615-04	Front glass		☆
—	B31-0616-05	Meter		☆
—	B30-0802-05	Plot lamp (white)		
—	B30-0803-05	Pilot lamp (Blue)		
—	B30-0106-05	Pilot lamp (Small)		
—	B42-1602-04	Sticker	(K)	
—	B46-0058-00	Warranty card	(K)	
—	B50-2614-00	Operating manual	(K)	☆
—	B50-2628-00	Operating manual	(W)	☆
—	B50-2629-00	Operating manual	(T)	☆
—	E04-0152-05	M type receptacle		
—	E06-0453-05	4P metal socket (MIC)	(W) (T)	☆
—	E06-0552-05	5P metal socket (MIC)	(K)	☆
—	E07-0451-05	4P metal consent	(W) (T)	☆
—	E07-0551-05	5P metal consent	(K)	☆
—	E08-0203-25	2P connector (Jack)		

Ref. No.	Parts No.	Description		Remarks
—	E08-0471-05	4P socket (TONE PAD)	(K)	
—	E09-0471-05	4P plug (TONE PAD)	(K)	
—	E09-0203-25	2P connector (Plug)		
—	E11-0003-15	Earphone jack		
—	E12-0061-05	Phone plug		
—	E23-0043-04	Antenna earth lag		
—	E23-0015-04	Earth lag		
—	F01-0731-05	Heat sink		☆
—	F05-4022-05	Fuse (4A) × 2		
—	F20-0078-05	Isulating plate		
—	F29-0014-05	Insulating washer		
—	G02-0505-05	Fitting spring for knob		
—	G11-0054-14	Insulating cushion × 2		
—	G13-0616-04	Cushion (A) × 2		☆
—	G13-0617-04	Cushion (B)		☆
—	H01-2590-03	Carton case (Inside)	(K) (W)	☆
—	H01-2607-03	Carton case (Inside)	(T)	☆
—	H10-2519-02	Cushion		☆
—	H10-2501-03	Styren foam cushion		
—	H12-0447-04	Cushion		☆
—	H20-1408-03	Protection cover		☆
—	H25-0049-03	Bag with accessory		
—	H25-0079-04	Polytylene bag (MIC)		
—	H25-0103-04	Polyetylene bag (Cord)		
—	J13-0029-05	Fuse holder		
—	J21-2608-03	C type angle		☆
—	J51-0006-15	Snap-lock × 2		
—	J61-0019-05	Vinyl tie		
—	K21-0724-04	Knob (Outside)		☆
—	K21-0731-03	Knob (Mode)	(K)	☆
—	K21-0732-03	Knob channel (A)		☆
—	K21-0733-03	Knob channel (B)		☆
—	K21-0741-03	Knob mode	(W) (T)	☆
—	K23-0717-04	Knob		☆
—	K23-0719-04	Knob MHz		☆
—	K29-0712-04	Knob push (square) × 2		☆
—	K29-0713-04	Knob push (circle) × 3		☆
—	N99-0304-04	Hex. socket screws × 4		☆
—	S31-1402-05	Slide switch (remote)		
—	S36-2402-05	See saw switch (power)		

PARTS LIST

Ref. No.	Parts No.	Description	Remarks
—	S40-2409-05	Push switch (M)	☆
—	S40-2404-05	Push switch (MR)	
—	S40-2403-05	Push switch SUB, HI/LOW (W) HI/LOW	
—	T07-0201-05	Speaker (8Ω)	
—	T91-0310-05	Microphone (K)	☆
—	T91-0302-05	Microphone (W)	
—	T91-0301-05	Microphone (T)	
—	W01-0401-04	Wrench (Hex)	☆
—	X44-1300-10	TX-RX unit	
—	X50-1580-10	PLL unit (K)	☆
—	X50-1580-61	PLL unit (W) (T)	☆
—	X52-1110-62	TONE unit (W)	☆
—	X52-1110-51	TONE unit (T)	☆
—	X54-1440-10	CONTROL unit (K)	☆
—	X54-1440-61	CONTROL unit (W) (T)	☆

TX-RX Unit (X44-1300-10)

Ref. No.	Parts No.	Description	Remarks
		CAPACITOR	
C1	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C2	CK45B1H102K	Ceramic 0.001μF ±10%	
C3,4	CS15E1V0R1M	Tantalum 0.1μF 16WV	
C5	CE04W1A470	Electrolytic 47μF 10WV	
C6	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C7	CE04W1C100	Electrolytic 10μF 16WV	
C8	CE04W1E4R7	Electrolytic 4.7μF 25WV	
C9	CE04W1A470	Electrolytic 47μF 10WV	
C10	CE04W1H010	Electrolytic 1μF 50WV	
C11	CQ92M1H103K	Mylar 0.01μF ±10%	
C12	CQ92M1H393	Mylar 0.039μF ±10%	
C13	CK45B1H102K	Mylar 0.001μF ±10%	
C14	CC45UJ1H020C	Ceramic 2pF ±0.25pF	
C15	CC45TH1H100D	Ceramic 10pF ±0.5pF	
C16,17	CK45B1H221K	Ceramic 220pF ±10%	
C18	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C19	CC45CH1150J	Ceramic 15pF ±5%	
C20	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C21	CC45SL1H101J	Ceramic 100pF ±5%	
C22	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C23～25	CC45CH1H330J	Ceramic 33pF ±5%	
C26,27	CK46F1H103Z	Ceramic 0.01μF +80,−20%	
C28,29	CC45TH1H150J	Ceramic 15pF ±5%	
C30	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C31	CK45B1H102K	Ceramic 100pF ±10%	
C32	CE04W1C100	Electrolytic 110μF 16WV	
C33	CC45CH1H050C	Ceramic 5pF ±0.25pF	
C34	CC45TH1H080D	Ceramic 8pF ±0.5pF	
C35	CC45CH1HOR5C	Ceramic 0.5pF ±0.25pF	
C36	CC45TH1H120J	Ceramic 12pF ±5%	
C37	CC45CH1HOR5C	Ceramic 0.5pF ±0.25pF	
C38	CC45TH1H120J	Ceramic 12pF ±5%	
C39	CC45CH1H270J	Ceramic 27pF ±5%	
C40	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C41	CK45B1H102K	Ceramic 0.001μF ±10%	
C42	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C43	CK45B1H102K	Ceramic 0.001μF ±10%	
C44	CC45CH1H070D	Ceramic 7pF ±0.5pF	
C45	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C46,47	CK45B1H102K	Ceramic 0.001μF ±10%	
C48	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C49	CC45CH1H330J	Ceramic 33pF ±5%	
C50	CE04W1A470	Electrolytic 47μF 100WV	
C51～54	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C55	CE04W1C220	Electrolytic 22μF 16WV	
C56,57	CC45SL2H150J	Ceramic 15pF ±5%	
C58,59	CC45SL2H680J	Ceramic 68pF ±5%	
C60	CC45SL2H150J	Ceramic 15pF ±5%	
C61	CC45SL2H270J	Ceramic 27pF ±5%	
C62	CC45SL2H330J	Ceramic 33pF ±5%	
C63	CC45SL2H220J	Ceramic 22pF ±5%	
C64～67	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C68	CC45CH1H010C	Ceramic 1pF ±0.25pF	
C69	CK45B1H102K	Ceramic 0.001μF ±10%	
C70	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C71	CC45CH1H330J	Ceramic 33pF ±5%	
C72	CC45RH1H070D	Ceramic 7pF ±0.5pF	
C73	CC45LH1H150J	Ceramic 15pF ±5%	
C74	CC45CH1H050C	Ceramic 5pF ±0.25pF	
C75	CC45CH1H220J	Ceramic 22pF ±5%	
C76	CC45RH1H070D	Ceramic 7pF ±0.5pF	
C77,78	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C79,80	CK45B1H102K	Ceramic 0.001μF ±10%	
C81,82	CM93F2A080D	Mica 8pF ±0.5pF	
C83	CC45SL1H010C	Ceramic 1pF ±0.25pF	
C84	CC45CH1H220J	Ceramic 22pF ±5%	
C85	CC45CH1H020C	Ceramic 2pF ±0.25pF	
C86	CC45CH1H180J	Ceramic 18pF ±5%	
C87	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C88	CK45B1H102K	Ceramic 0.001μF ±10%	
C89	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C91	C91-0405-05	Trough type capacitor 0.001μF	
C92	CK45B1H221K	Ceramic 220pF ±10%	
C93,94	CQ92M1H223K	Mylar 0.022μF ±10%	
C95	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C96	CK45B1H471K	Ceramic 470pF ±10%	
C97	CC45SL1H151J	Ceramic 150pF ±5%	
C98	CC45CH1H150J	Ceramic 15pF ±5%	
C99	CQ92M1H223K	Mylar 0.022μF ±10%	
C101	CK45B1H471K	Ceramic 470pF ±10%	
C102	CQ92M1H103K	Mylar 0.01μF ±10%	
C103	CK45B1H471K	Ceramic 470pF ±10%	
C104,105	CQ92M1H223K	Mylar 0.022μF ±10%	
C106	CK45B1H471K	Ceramic 470pF ±10%	
C107	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C108	CQ92M1H153K	Mylar 0.015μF ±10%	
C109	CC45CH1H470J	Ceramic 47pF ±5%	
C110,111	CK45B1H471K	Ceramic 470pF ±10%	
C112	CQ92M1H472K	Mylar 0.0047μF ±10%	
C113,114	CK45B1H471K	Ceramic 470pF ±10%	
C115	CQ92M1H102K	Mylar 0.001μF ±10%	
C116	CQ92M1H473K	Mylar 0.047μF ±10%	
C117	CQ92M1H223K	Mylar 0.022μF ±10%	
C118	CQ92M1H102K	Mylar 0.001μF ±10%	
C119	CQ92M1H222K	Mylar 0.0022μF ±10%	
C120	CQ92M1H393K	Mylar 0.039μF ±10%	
C121	CQ92M1H222K	Mylar 0.0022μF ±10%	
C122	CQ92M1H103K	Mylar 0.01μF ±10%	
C123	CS15E1V0R1M	Tantalum 0.1μF 16WV	
C124	CQ92M1H333K	Mylar 0.033μF ±10%	
C125	CQ92M1H222K	Mylar 0.0022μF ±10%	
C126	CS15E1C4R7M	Tantalum 4.7μF 16WV	
C127	CE04W1H3R3	Electrolytic 3.3μF 50WV	
C128	CK45F1H103Z	Ceramic 0.01μF +80,−20%	

PARTS LIST

Ref. No.	Parts No.	Description	Remarks
C129	CQ92M1H103K	Mylar 0.01μF ±10%	
C130	CQ92M1H332K	Mylar 0.0033μF ±10%	
C131	CQ92M1H273K	Mylar 0.027μF ±10%	
C132	CE04W1H010	Electrolytic 1μF 50WV	
C133	CE04W1C100	Electrolytic 10μF 16WV	
C134	CE04W1A470	Electrolytic 47μF 10WV	
C135	CE04W1C100	Electrolytic 10μF 16WV	
C136	CE04W1A101	Electrolytic 100μF 10WV	
C138,139	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C140	CE04W1C220	Electrolytic 22μF 16WV	
C141	CK451H103Z	Ceramic 0.01μF +80,−20%	
C142	CE04W1C100	Electrolytic 10μF 16WV	
C143	CE04W1A470	Electrolytic 47μF 10WV	
C144～147	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C148	CE04W1C220	Electrolytic 22μF 16WV	
C149	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C150	CE04W1C220	Electrolytic 22μF 16WV	
C151	C91-0405-05	Trough type capacitor 0.001μF	
C152	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C153	CC45SL1H330J	Ceramic 33pF ±5%	
C154	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C155	CE04W1C101Q	Electrolytic 100μF 16WV	
C156	CC45CH1H050C	Ceramic 5pF ±0.25pF	
C157～159	CC45TH1H020C	Ceramic 2pF ±0.25pF	
RESISTOR			
R29	RS14GB3D3R3J	Resistor (Metal Film) 3.3Ω	
SEMICONDUCTOR			
Q1	V03-0039-05	IC TA7061AP	
Q2,3	V03-0079-05	Transistor 2SC460 (B)	
Q4,5	V09-0012-05	FET 2SK19 (GR)	
Q6	V09-1002-56	FET 3SK74 (L)	
Q7	V03-2053-06	Transistor 2SC2053	☆
Q8,9	V09-1002-56	FET 3SK74 (L)	
Q10～17	V03-0079-05	Transistor 2SC460 (B)	
Q18～22	V03-1815-06	Transistor 2SC1815 (Y)	
Q23,24	V03-0336-05	Transistor 2SC496 (Y)	
Q25	V01-1015-06	Transistor 2SA1015 (Y)	
Q27	V03-1959-06	Transistor 2SC1959 (Y)	☆
Q28～30	V03-1815-06	Transistor 2SC1815 (Y)	
Q31	V01-0113-05	Transistor 2SA496 (Y)	
D1～5	V11-0317-05	Diode 1S2208	
D6	V11-0076-05	Diode 1S1555	
D7	V11-5260-16	Diode MI402	
D8	V11-0414-05	Diode 1S2588	
D9～12	V11-0051-05	Diode 1N60	
D13～16	V11-0076-05	Diode 1S1555	
D17～20	V11-0051-05	Diode 1N60	
D21	V11-0076-05	Diode 1S1555	
D22	V11-1262-06	Varistor 1S1212	
D23	V11-4163-56	Zener diode XZ-088	
D24	V11-0076-05	Diode 1S555	
D25	V11-0247-05	Zener diode WZ-100	
D26	V11-0076-05	Diode 1S1555	
D27	V11-0243-05	Zener diode WZ-061	
D28	V11-0076-05	Diode 1S1555	
POTENTIOMETER			
VR1,2	R12-1404-05	Potentiometer P6-S3NA 4.7kΩ	
VR3	R12-0406-05	Potentiometer P6-S3NA 470Ω	

Ref. No	Parts No.	Description	Remarks
VR4	R12-1404-05	Potentiometer P6-S3NA 4.7kΩ	
VR5	R12-0406-05	Potentiometer P6-S3NA 470Ω	
VR6	R12-5403-05	Potentiometer P6-S3NA 100kΩ	
VR7	R12-4404-05	Potentiometer P6-S3NA 68kΩ	
VR8	R12-1404-05	Potentiometer P6-S3NA 4.7kΩ	
VR9	R12-0406-05	Potentiometer P6-S3NA 470Ω	
TRIMMER			
TC1	C05-0062-05	Ceramic trimmer 6pF ECV1ZW6P	
TC2	C05-0013-15	Ceramic trimmer 20pF ECV1ZW20P	
COIL/INDUCTOR/CRYSTALQUARTZ			
L1	L40-1021-03	Ferri inductor 1mH	
L2	L40-1545-06	Ferri inductor 150mH	
L3	L77-0710-05	Crystal quartz (10.7 MHz)	
L4	L33-0615-05	Choke coil 15μH	
L5	L30-0005-05	IFT	
L6	L31-0313-05	IFT	
L7	L40-3391-03	Ferri inductor 3.3μH	
L8	L40-1021-03	Ferri inductor 1 mH	
L9	L31-0344-05	Tuning coil	
L10	L31-0180-05	Tuning coil	
L11,12	L31-0267-05	Tuning coil	
L13	L34-0672-05	Tuning coil	
L14	L40-1021-03	Ferri inductor 1 mH	
L15	L34-0814-05	VHF coil 4φ4T	☆
L16	L34-0452-05	VHF coil 3φ6T	
L17	L40-1001-03	Ferri inductor 10μH	
L18	L33-0074-05	Choke coil 0.3μH	
L19	L34-0813-05	VHF coil 4φ3T	☆
L20	L34-0819-05	VHF coil 5φ7T	☆
L21	L34-0816-05	VHF coil 5φ2T	☆
L22	L34-0815-05	VHF coil 5φ1T	☆
L23	L34-0814-05	VHF coil 4φ4T	☆
L24	L34-0817-05	VHF coil 5φ3T	☆
L25	L39-0052-05	Inspecting coil	
L26	L33-0002-05	Choke coil 1μH	
L27	L34-0818-05	VHF coil 5φ4T	☆
L28	L33-0025-05	Choke coil 1μH	
L29,30	L34-0694-05	Tuning coil	
L31	L34-0812-012	Tuning coil	☆
L32	L79-0451-05	Helical block	☆
L33	L34-0812-05	Tuning coil	☆
L34	L34-0683-05	Tuning coil	☆
L35	L30-0289-05	IFT	
L36	L71-0201-05	Monolitic filter 10F15A	
L37	L30-0289-05	IFT	
L38	L72-0014-05	Ceramic filter SFE-10.7 MA5	
L39	L77-0327-05	Crystal quartz (10.245 MHz)	
L40	L40-1021-03	Ferri inductor 1 mH	
L41	L72-0309-05	Ceramic filter CFT-455FZ	
L42	L30-0504-05	IFT	
L43	L30-0503-05	IFT	
L44	L79-0442-05	Ceramic discri 455-D	
L45	L40-6825-04	Ferri inductor 6.8 mH	
L46	L40-1021-03	Ferri inductor 1 mH	
MISCELLANEOUS			
	E23-0046-04	Terminal (square) × 16	
	E23-0401-05	Terminal (circle)	

PARTS LIST

PLL Unit (X50-1580-10)

Ref. No.	Parts No.	Description			Remarks
		CAPACITOR			
C1～6	CK451H103Z	Ceramic	0.01μF	+80,−20%	
C7～12	CJ45B1H102K	Ceramic	0.001μF	±10%	
C13	CC45CH1H100D	Ceramic	10pF	±0.5pF	
C14	CC45CH1H270J	Ceramic	27pF	±0.5%	
C15	CC45UJ1H180J	Ceramic	18pF	±5%	
C16	CK45F1H103Z	Ceramic	0.01μF	+80,−20%	
C17	CE04W1A470	Electrolytic	47μF	10WV	
C18,19	CC45LH1H050C	Ceramic	5pF	±0.25pF	
C20	CE04W1A470	Electrolytic	47μF	10WV	
C21,22	CK45F1H103Z	Ceramic	0.01μF	+80,−20%	
C23	CE04W1C101Q	Electrolytic	100μF	16WV	
C24～26	CK45F1H103Z	Ceramic	0.01μF	+80,−20%	
C27	CC45CH1H330J	Ceramic	33pF	±5%	
C28	CC45CH1H050C	Ceramic	5pF	±0.25pF	
C29	CE04W1H010	Electrolytic	1μF	50WV	
C30	CK45F1H103Z	Ceramic	0.01μF	+80,−20%	
C31	CC45CH1H100D	Ceramic	10pF	±0.5pF	
C32～35	CK45F1H103Z	Ceramic	0.01μF	+80,−20%	
C36	CC45CH1H050C	Ceramic	5pF	±0.25pF	
C37	CK45F1H103Z	Ceramic	0.01μF	+80,−20%	
C38	CS15E1C4R7M	Tantalum	4.7μF	16WV	
C39	CS15E1A100M	Tantalum	10μF	10WV	
C40	CC45CH1H050C	Ceramic	5pF	±0.25pF	
C41	CC45CH1H270J	Ceramic	27pF	±0.5%	
C42	CC45CH1H220J	Ceramic	22pF	±5%	
C43～53	CK45F1H103Z	Ceramic	0.01μF	+80,−20%	
C54	CE04W1E4R7	Electrolytic	4.7μF	25WV	
C55	C90-0246-05	Ceramic	0.01μF	±10%	
C56	CE04W1C100	Electrolytic	10μF	16WV	
C57	CK45F1H103Z	Ceramic	0.01μF	+80,−20%	
C58	CC45SL1H101J	Ceramic	100pF	±5%	
C59	CK45F1H103Z	Ceramic	0.01μF	+80,−20%	
C60,61	CC46CH1H220J	Ceramic	22pF	±5%	
C62	CE04W1A470	Electrolytic	47μF	10WV	
C63,64	CK45F1H103Z	Ceramic	0.01μF	+80,−20%	
C65,66	CQ92M1H332K	Mylar	0.0033μF	±10%	
C67	CQ92M1H103K	Mylar	0.01μF	±10%	
C68	CQ92M1H472K	Mylar	0.0047μF	±10%	
C69	CE04W1H010	Electrolytic	1μF	50WV	
C70	CQ92M1H332K	Mylar	0.0033μF	±10%	
C71	CE04W1A101Q	Electrolytic	100μF	10WV	
C72	CQ92M1H102K	Mylar	0.001μF	±10%	
C73	CK453B1H331K	Ceramic	330pF	±10%	
C74	CQ92M1H472K	Mylar	0.0047μF	±10%	
C75	CE04W1C101Q	Electrolytic	100μF	16WV	
C76	CE04W1C100	Electrolytic	10μF	16WV	
C77	CE04W1A330	Electrolytic	33μF	10WV	
C78	CQ92M1H303K	Mylar	0.039μF	±10%	
C79	CE04W1A330	Electrolytic	33μF	10WV	
C80	CE04W1A101Q	Electrolytic	100μF	10WV	
C81	CQ92M1H104K	Mylar	0.1μF	±10%	
C82	CE04W1C471Q	Electrolytic	470μF	16WV	
C84	CE04W1A470	Electrolytic	47μF	10WV	
C85	CC45CH1H070D	Ceramic	7pF	±0.5pF	
C86	CC45CH1H150J	Ceramic	15pF	±5%	
C87	CC45CH1H030C	Ceramic	3pF	±0.25pF	
C88	CK45F1H103Z	Ceramic	0.01μF	+80,−20%	
C89	CE04W1C100	Electrolytic	10μF	16WV	
C90	CK45B1H102K	Ceramic	0.001μF	±10%	
C91	CC45CH1H030C	Ceramic	3pF	±0.25pF	
C92	CC45UJ2H020C	Ceramic	1pF	±0.25pF	
C93	CC45CH1H080D	Ceramic	8pF	±0.5pF	
C94	CQ92M1H103K	Mylar	0.01μF	±10%	
C95	CC45UJ1H060D	Ceramic	6pF	±0.5pF	
		SEMICONDUCTOR			
Q1～5	V03-1815-06	Transistor	2SC1815 (Y)		
Q6	V03-0079-05	Transistor	2SC460 (B)		
Q7,8	V03-1815-06	Transistor	2SC1815 (Y)		
Q9	V03-1959-06	Transistor	2SC1959 (Y)		
Q10	V01-0113-05	Transistor	2SA496 (Y)		
Q11,12	V09-1002-56	FET	3SK74 (L)		
Q13,14	V03-1815-06	Transistor	2SC1815 (Y)		
Q15	V30-1030-46	IC	SM5111A		☆
Q16	V03-1815-06	Transistor	2SC1815 (Y)		
Q17	V03-0272-05	Transistor	2SC1345 (E)		
Q18	V03-1815-06	Transistor	2SC1815 (Y)		
Q19	V30-0087-05	IC	TA7060P		
Q20	V03-1923-06	Transistor	2SC1923 (O)		☆
Q21,22	V03-1815-06	Transistor	2SC1815 (Y)		
Q23,24	V03-2240-06	Transistor	2SC2240 (GR)		
Q25	V30-0208-05	IC	AN315		
Q26	V09-0060-05	FET	2SK30A (GR)		
Q27	V09-1001-16	FET	2SK19 (GR) (T)		
Q28	V03-1923-06	Transistor	2SC1972 (O)		☆
D1～5	V11-0414-05	Diode	1S2588		
D6～10	V11-4161-36	Diode	1SV53A		
D11～20	V11-0076-05	Diode	1S1555		
D21	V11-0374-05	Diode	1SS16		
D22	V11-4161-16	Zener diode	XZ-061		
D23,24	V11-0414-05	Diode	1S2588		
D25	V11-4161-56	Zener diode	WZ-040		☆
D26	V11-0317-05	Diode	1S2208		
		POTENTIOMETER			
VR1～5	R12-5403-05	Potentiometer 100kΩ			
VR6,7	R12-1403-05	Potentiometer 1kΩ			
		TRIMMER			
TC1	C05-0067-05	Ceramic trimmer 5P			
TC2	C05-0062-05	Ceramic trimmer 6P			
		COIL/INDUCTOR			
L1～5	L34-0437-05	Choke coil			☆
L6	L77-0832-05	Crystal quartz 43.7667 MHz			☆
L7	L77-0833-05	Crystal Quartz 44.4333 MHz			☆
L8	L77-0834-05	Crystal Quartz 43.5667 MHz			☆
L9	L77-0835-05	Crystal Quartz 44.2333 MHz			☆
L10	L77-0836-05	Crystal Quartz 44.6333 MHz			☆
L11	L40-1511-03	Ferri-inductor 150μH			
L12	L33-0605-05	Choke coil 0.47μH			
L13	L32-0002-05	Oscillator coil			
L14	L34-0683-05	Tuning coil			
L15	L34-0820-05	Tuning coil			☆
L16	L34-0683-05	Tuning coil			
L17	L77-0720-05	Crystal Quartz 10.240 MHz			
L18	L40-2201-03	Ferri-inductor 22μH			
L19	L40-1091-03	Ferri-inductor 1μH			
L20	L15-0016-05	Choke coil (Low frequency)			
L21,22	L40-1021-03	Ferri-inductor 1mH			
L23	L40-3391-03	Ferri-inductor 3.3μH			
L25	L32-0618-05	Oscillator coil			☆
		MISCELLANEOUS			
	E23-0046-04	Terminal × 8 (square)			
	E23-0401-05	Terminal × 2 (circle)			

PARTS LIST/PACKING

CONTROL UNIT (X54-1440-10)

Ref. No.	Parts No.	Description	Remarks
		CAPACITOR	
C1	CE04W1C470Q	Electrolytic 47μF 16WV	
C2	CE04W1A470	Electrolytic 47μF 10WV	
R1,2	R90-0514-05	Resistor block 10k×7	
R3～5	R90-0516-05	Resistor network	
R6	R90-0515-05	Resistor block 10k×4	
Q1～6	V03-1815-06	Transistor 2SC1815 (Y)	
Q7	V01-1015-06	Transistor 2SC1015 (Y)	
IC1～3	V30-1006-46	IC TC4035BP	☆
IC4～6	V30-0232-26	IC TC4019BP	
IC7～9	V30-0232-76	IC TC5022BP	
IC10,11	V30-1006-36	IC TC4081BP	☆
IC12	V30-1025-26	IC FS7806M	☆
D1～22	V11-0051-05	Diode 1N60	
D23	V11-0076-05	Diode 1S1555	
D24	V11-0307-05	Zenner diode WZ-150	
D25	V11-3162-86	LED TLG205	☆
D26	V11-3162-96	LED TLR205	☆
D27～30	V11-4161-66	LED 513 OK	☆
S1	S29-1406-05	Rotary switch (1 MHz) K	☆
S4	S29-1408-05	Rotary switch (1 MHz) W	☆
S2	S29-1405-05	Rotary switch (1000 kHz, 10 kHz)	☆
S3	S40-2405-05	Push switch (0k, 5k)	
S4	S29-4402-05	Slide rotary (for shift)	☆

TONE UNIT (X52-1110-50) (T TYPE) (X52-1110-61) (W TYPE)

Ref. No.	Parts No.	Description	Remarks
C1	CD45B1H102K	Ceramic 1000pF ±10%	
C2	CE04W1C220Q	Electrolytic 22μF 16WV	
C3～5	C91-0433-05	Layer-built 0.0039μF ±5%	☆
C6	CE04W1C220Q	Electrolytic 22μF 16WV	
C7,8	CE04W1H010	Electrolytic 1μF 50WV	
C9,10	CK45B1H102K	Ceramic 1000pF ±10%	
C11	CS15E1A150K	Tantalum 15μF ±10%	(T)
C12	CK45B1H102K	Ceramic 1000pF ±10%	
C13	CS15E1A150K	Tantalum 15μF ±10%	(T)
		RESISTOR	
R1～12	RD14CB2E○○○J But	Carbon ○○○Ω ±5% 1/W	
R2,3	R92-0616-05	Metal film 10kΩ ±1% 1/W	☆
R4	R92-0617-05	Metal film 7.5kΩ ±1% 1/W	☆
R5	RN14BK2E4703F	Metal film 470kΩ ±1% 1/W	
R10	RD14CB2E102J	Carbon 15kΩ ±5% 1/W	(T)
		SEMICONDUCTOR	
Q1,2		Transistor 2SC458 (B)	
D1,2		Diode 1S1555	(T)
D1		Diode 1S1555	(W)
		POTENTIOMETER	
VR1	R12-2405-05	Semi-fixed resistor 5kΩ	☆
VR2	R12-4403-05	Semi-fixed resistor 50kΩ	(T)☆
		MISCELLANEOUS	
—	E40-0464-05	Pin plug	

PACKING

ACCESSORIES SUPPLIED

1. Dynamic microphone equipped with
   5-pin plug (T91-0310-05) (K)..... 1 piece
   4-pin plug (T91-0301-05) (T)
   4-pin plug (T91-0302-05) (W)
2. Mounting bracket (J21-2608-03)..... 1 piece
3. Mounting parts
   Hex. socket screws (N99-0304-04)..... 4 pieces
   Screws, 6 mm diameter (N09-0008-04)..... 4 pieces
   Plain washers, 6 mm diametr
   (N15-1060-46)..... 4 pieces
   Spring washers, 6 mm diameter
   (N16-0060-41)..... 4 pieces
   Nuts, 6 mm diameter (N14-0009-04) ..... 4 pieces
4. Snap-lock (J51-0006-15) ..... 2 pieces
5. Label ..... 1 sheet
6. Spare fuse, 4A (F05-1031-05) ..... 1 piece
7. DC power cord with plug and fuse..... 1 piece
8. Miniature plug for external speaker
   (E12-0001-05) and touch tone pad
   (E08-0471-05) ..... 2 pieces
   (E09-0471-05)
9. Operating manual (B50-2614-00) (K) ..... 1 copy
   (B50-2628-00) (W)
   (B50-2629-00) (T)

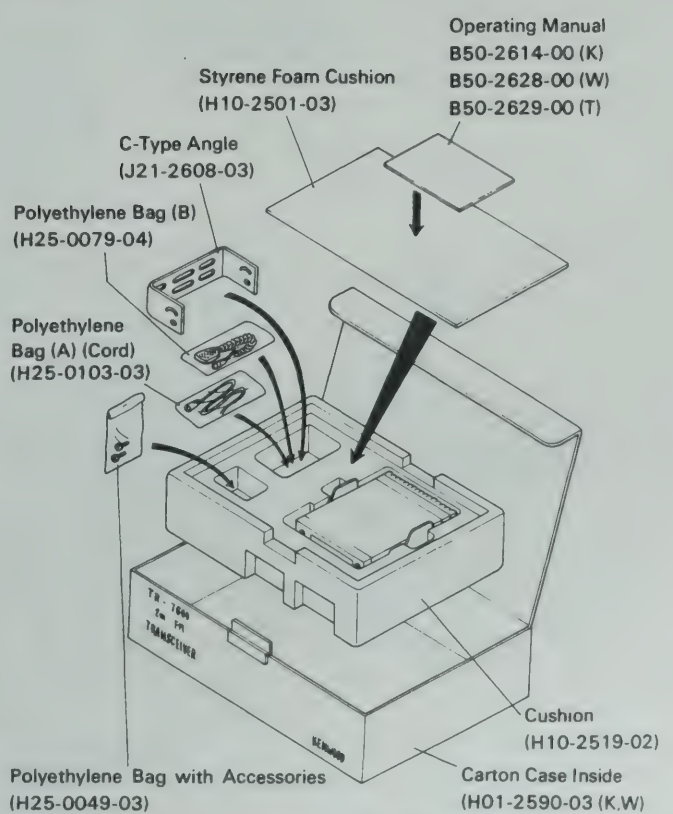


Fig. 9 Packing

EXPLODED VIEW

I. Removing the case
(1) Remove the bind screws ① ~ ⑪.
(2) Remove the upper and 2 lower cases.

II. Removing the panel
(1) Remove the knobs.
(2) Remove the screws Ⓐ ~ Ⓓ

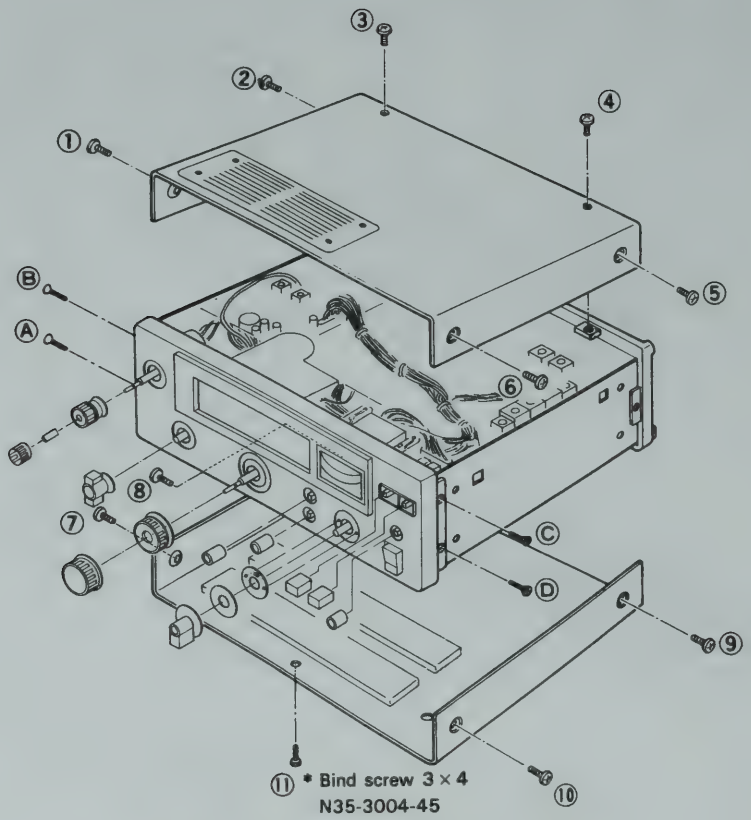


Fig. 10 Removing the Panel and Case

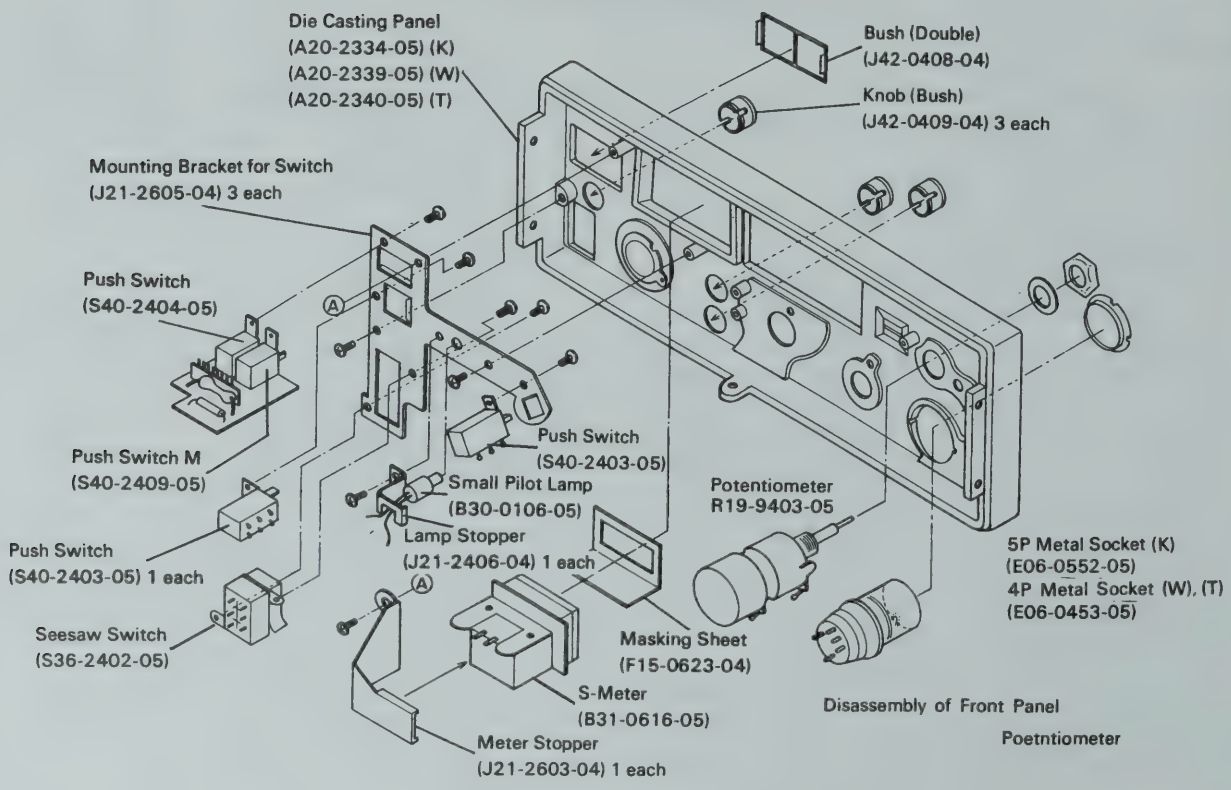
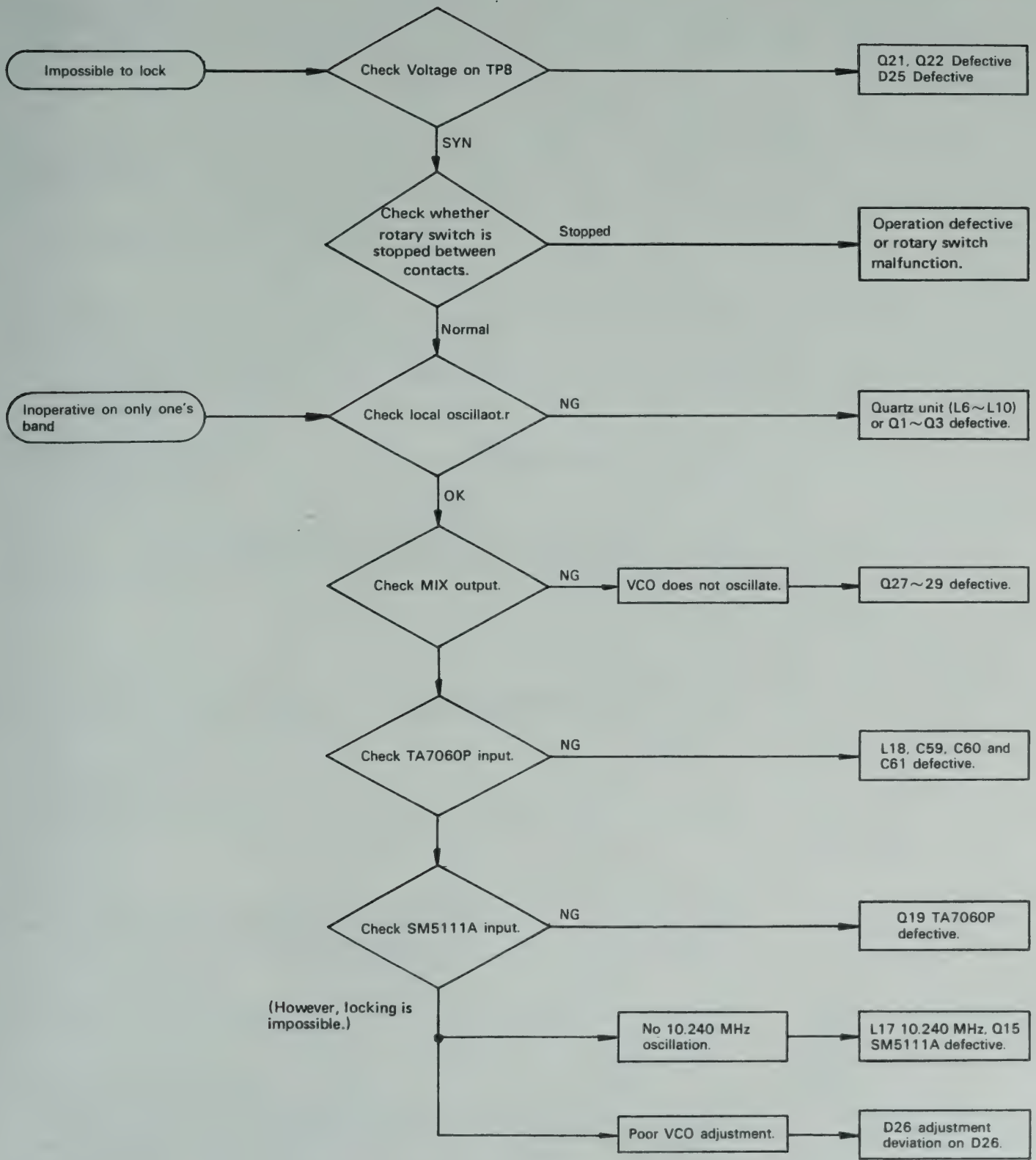


Fig. 11 Disassembly of Front Panel

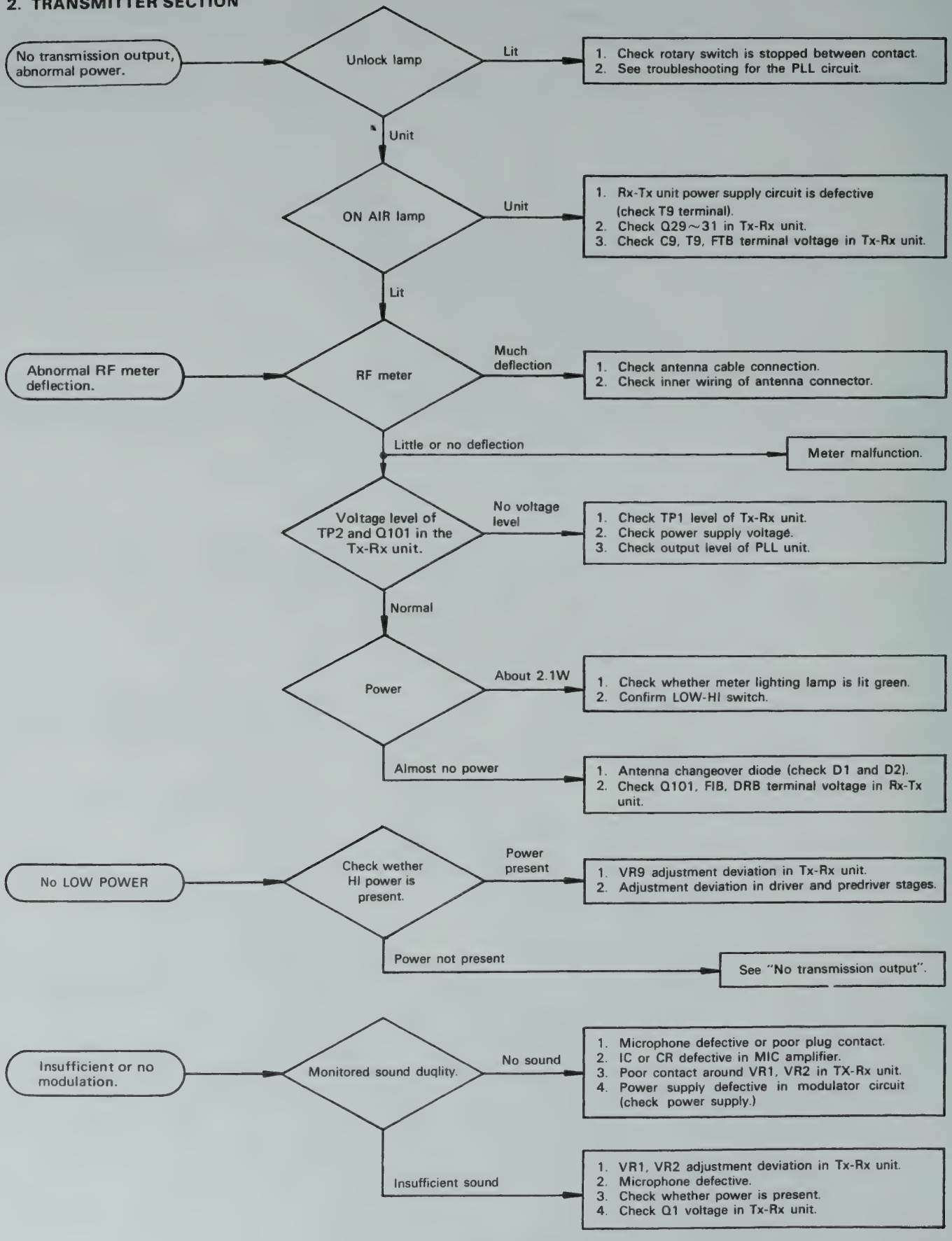
TROUBLESHOOTING

1. PLL CIRCUIT



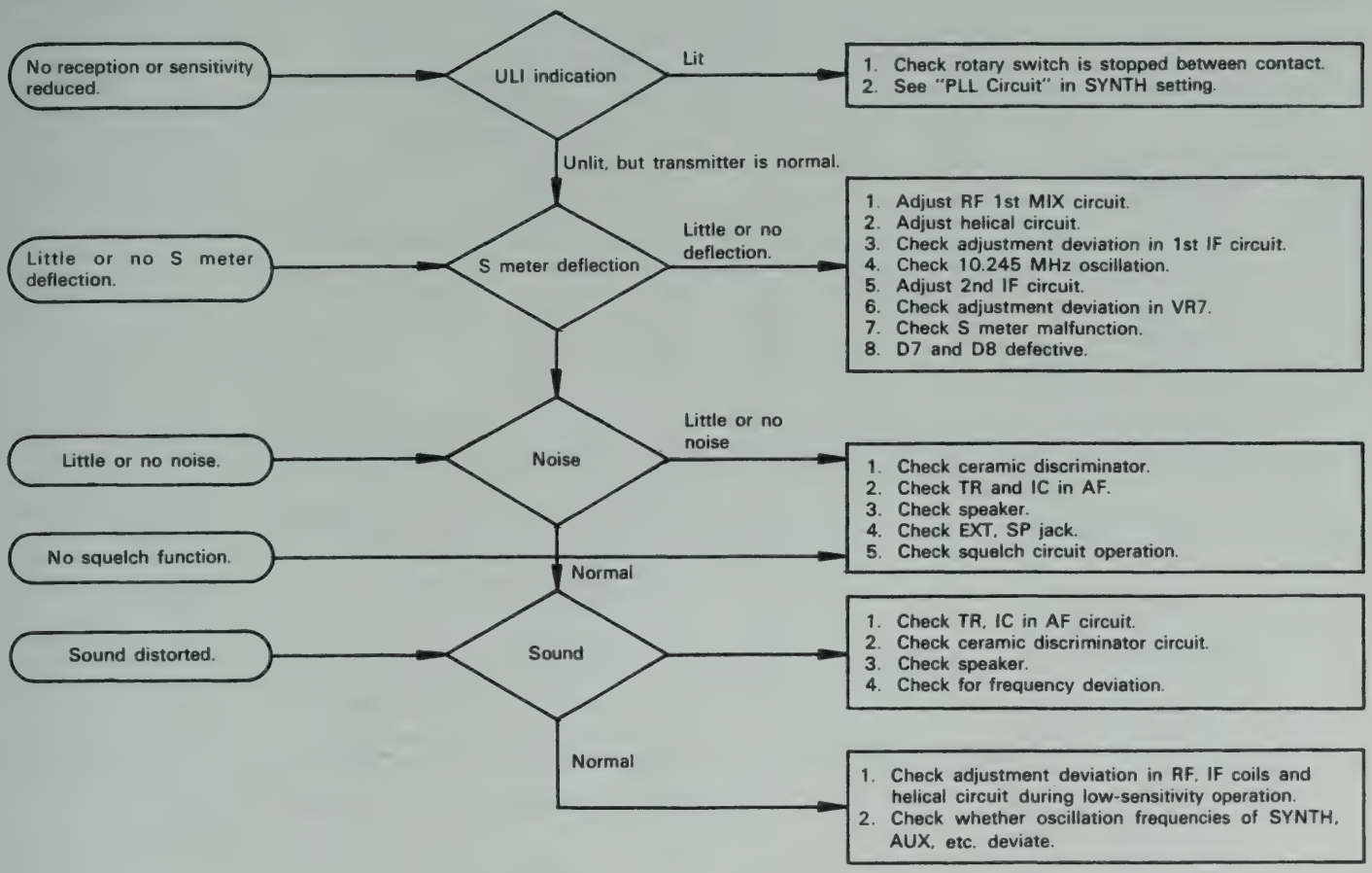
TROUBLESHOOTING

2. TRANSMITTER SECTION



TROUBLESHOOTING/ADJUSTING

3. RECEIVER SECTION



ADJUSTMENT

TEST EQUIPMENT REQUIRED

1. DC Power Supply
- Voltage: Variable from 9 to 16 V.
- Current: 4 A min.

2. DC Voltmeter
- Voltage range: 10 V~16 V (min.)
- Input inpedance: Sufficient (1MΩ/VDC)

3. RF Valve Voltmeter
- Voltage range: F.S. 10 mV~300 V
- Measuring frequency: 200 MHz min.
- Input impedance: 1 MΩ min., 3 pF max.

4. Frequency Counter
- Measuring frequency: 150 MHz min.
- Min. input sensitivity: about 50 mV

5. Oscilloscope:
With horizontal input terminal and high sensitivity.
- Measuring frequency: 3 MHz min.

6. Power Meter
- Measuring frequency: 150 MHz min.
- Impedance: 50Ω
- Measuring range: 20W, 3W

7. Linear Detector

8. AG
- Frequency range: 300 Hz~5 kHz
- Output: 0.5 mV~1 V

9. AF Valve Voltmeter
- Measuring frequency: 50 Hz 10 kHz
- Input impedance: 1 MΩ min.
- Voltage range: F.S. 3 mV~30 V

10. SSG
- Output frequency: Capable of covering 144 MHz ~148 MHz
- Modulation: Frequency modulation is possible.

11. Sweep Generator
- Frequency range: Capable of covering 144 MHz ~148 MHz

12. Dummy
8Ω 5W (approx.)

13. Directional Coupler

14. Detector

ADJUSTMENT

1. Adjustment of PLL circuit

Item	Condition	Measuring point			Adjusting point			Reference	Remarks
		(Measure instruments)	Unit	Terminal	Unit	Parts	Method		
1. Voltage check and adjustment	1) POWER SW: ON HI/LOW SW: HI MR SW: OFF MODE SW: S MHz SW: 6 100 kHz SW: 0 10 kHz SW: 0 SUBTONE SW: O 5Hz SW: 0 REMOTE SW: OFF SEND/REC. SW: SEND	DC V.M	PLL	T9 (J1)				8.9V～10.2V	Confirm
			TX.RX	T9				8.9V～10.2V	Confirm
				EB				Approx. 12V	Confirm
	2) SEND/REC. SW: REC.	DC V.M	TX.RX	R9				7.7V～8.3V	Confirm
	3) Same as above.	DC V.M	PLL	TP3	PLL	VR7	8.0V	±0.2V	
	4) Same as item 2)	DC V.M	PLL	TP8	PLL	VR6	6.0V	±0.2V	
2. PLL	1) 100 kHz SW: 0 10 kHz SW: 0	RF V.M	PLL	TP1	PLL	L13	Turn the L13 core counter clockwise (180°) from the oscillation start point.	0.46V	
				TP7		L14 L16	MAX	1.4V	
	2) MHz SW: 4	DC V.M	PLL	TP5	PLL	TC2	1.5V	±0.05V	
	3) MHz SW: 7 100 kHz SW: 9 10 kHz SW: 9	DC V.M	PLL	TP5				Less than 5.5V	Confirm
	4) Same as above	F.Count	PLL	TP6	PLL	TC1	10.24000 Hz	±100 Hz	
	5) MHz SW: 4 100 kHz SW: 0 10 kHz SW: 0 5 kHz SW: 5 kHz	Frequency Counter	PLL	TP4	PLL	L1	133.3050 MHz	±100 Hz	
	6) MHz SW: 6					L2	135.3050 MHz	±100 Hz	
	7) MHz SW: 5 MODE SW: ⊖					L3	133.7050 MHz	±100 Hz	
	8) MHz SW: 7					L4	135.7050 MHz	±100 Hz	
	9) MODE SW: ⊕					L5	136.9050 MHz	±100 Hz	
Calibration of counter at 10.24 MHz	When a frequency counter is connected to the TP6 of the PLL unit, the 10.24 MHz signal is devited because of the impedance, so the counter should be calibrated using the following procedure. MHz SW: 4 100 kHz SW: 0 10 kHz SW: 0 ↓ MHz SW: 5	Frequency Counter	PLL	TP4	PLL	TC1	With the MHz SW set to "4" and "5" check that the signal on the TP6 is 10.24 MHz at each position when the TC1 is adjusted so that the signal of 100 Hz order on the TP4 remains unchanged.		
	10) MHz SW: 4 5 kHz SW: 0 MODE SW: S SEND/REC. SW: REC.		PLL	TP4	PLL	VR1	133.3000 MHz	±100 Hz	
	11) MHz SW: 6					VR2	135.3000 MHz	±100 Hz	
	12) MHz SW: 5 MODE SW: ⊖ SEND/REC. SW: SEND					VR3	133.7000 MHz	±100 Hz	
	13) MHz SW: 7					VR4	135.7000 MHz	±100 Hz	
	14) MODE SW: ⊕ Recheck the frequencies in Item (5) through (9). If they are devited, readjust L1 through L5.					VR5	136.9000 MHz	±100 Hz	

ADJUSTMENT

Item	Condition	Measuring point			Adjusting point			Reference	Remarks
		(Measure instruments)	Unit	Terminal	Unit	Parts	Method		
	15) MHz SW: 5 100 kHz SW: 9 10 kHz SW: 9 MODE SW: S SEND/REC. SW: REC.		PLL	TP4				135.2900 MHz±100 Hz	Confirm
	16) MHz SW: 7							137.2900 MHz ±100 Hz	Confirm
	17) MHz SW: 5 MODE SW: ⊖ SEND/REC. SW: SEND							134.6900 MHz±100 Hz	Confirm
	18) MHz SW: 7							136.6900 MHz±100 Hz	Confirm
	19) MHz SW: 4 100 kHz SW: 0 10 kHz SW: 0							132.7000 MHz±100 Hz	Confirm
	20) MHz SW: 6	Frequency Counter	PLL	TP4				134.7000 MHz±100 Hz	Confirm
	21) MHz SW: 5 SEND/REC. SW: REC.							134.3000 MHz±100 Hz	Confirm
	22) MHz SW: 7							136.3000 MHz±100 Hz	Confirm
	23) MHz SW: 6 MODE SW: ⊕							135.9000 MHz±100 Hz	Confirm
	24) MHz SW: 7 SEND/REC. SW: REC.							136.3000 MHz±100 Hz	Confirm
	25) MHz SW: 4 SEND/REC. SW: SEND & REC.							133.3000 MHz±100 Hz	Confirm
	26) MHz SW: 5 SEND/REC. SW: SEND & REC.							134.3000 MHz±100 Hz	Confirm
	27) MHz SW: 4→5→6→7→4 MODE SW: S SEND/REC. SW: REC.		PLL	TP4				The frequency should become higher than 133.3000 MHz in 1 MHz steps and should return to the original frequency at the "4" position.	Confirm
	28) 100 kHz SW: 0→1→ ..... 9→0							The frequency should become higher than 133.3000 MHz in 100 kHz steps and should return to the original frequency at the "0" position.	Confirm
	29) 10 kHz SW: 0→1→ ..... 9→0							The frequency should become higher than 133.3000 MHz in 10 kHz steps and should return to the original frequency at the "0" position.	Confirm
	30) MHz SW: 6 SEND/REC. SW: SEND	RF V.M	PLL	TP4	PLL	L15	MAX		
3. Paint lock	1) L1. L2. L3. L4. L5. L13								

ADJUSTMENT

2. Adjustment of TX section

Item	Condition	Measuring point			Adjusting point			Reference	Remarks
		(Measure instruments)	Unit	Terminal	Unit	Parts	Method		
1. SET	1) POWER SW: ON HI/LOW SW: HI MR SW: OFF MODE SW: S MHz SW: 4 100 kHz SW: 0 10 kHz SW: 0 5 kHz SW: 0 SUBTONE SW: OFF REMOTE SW: OFF SEND/REC. SW: SEND TC 1: Centered TC 2: Centered VR8: Full counter clockwise (FCCW)								
2. 10.7 MHz	1) Ready for UNLOCK	RF. V.M	TX.RX	TP1	TX.RX	L5,L6	MAX	0.4 V	
	2) Same as above	F.Counter	TX.RX	TP1	TX.RX	TC1	10.7000 MHz	±100 Hz	
3. VCT	1) Ready for UNLOCK MHz SW: 4→5→6→7	DC V.M	TX.RX	TP3				Check voltage goes down step by step	Confirm
4. B.P.F DRIVE	1) MHz SW: 6	RF V.M	TX.RX	gate	TX.RX	L9. 10 L11. VR3	MAX Repeat the same procedure two or three times.	1.2 V	Adjust the setting range of RF voltmeter for peak value.
	2) MHz SW: 7 100 kHz SW: 9 10 kHz SW: 9	RF V.M	TX.RX	TP2	TX.RX	L12, 13	Repeat the same procedure two or three times.		
	3) MHz SW: 4 100 kHz SW: 0 10 kHz SW: 0	RF V.M.	TX.RX	RFI	TX.RX	L13	MAX		Use to RF prove 100 : 1
5. POWER	1) POWER SW: OFF Power module lead: Soldering a RFT terminal.								
	2) MHz SW: 6 100 kHz SW: 0 10 kHz SW: 0 POWER SW: ON	POWER METER			TX.RX	TC2	MAX		
	3) Same as above	POWER. M DC A.M	rear panel	ANT.	TX.RX	L19	Adjust for 12W (if the power is less than 12 W make adjustment according to the procedure in Item (4) below.	Less than 3.0A	
	4) Same as above	POWER.M DC A.M			TX.RX	TC2	Adjust L19 to increase to capacity.		
	5) MHz SW: 4	POWER.M DC A.M						More than 10 W	Confirm
	6) MHz SW: 7 100 kHz SW: 9 10 kHz SW: 9	POWER.M DC A.M						More than 10 W Less than 3 A	Confirm
6. RF METER	1) MHz SW: 6 100 kHz SW: 0 10 kHz SW: 0 TX.RX unit VR6: Center	RF METER	front panel		TX.RX	L21 L22	Adjust L22 so that meter indicates "8" on the scale		
	2) Same as above	RF METER			TX.RX	VR6	Meter indicates "8".		
7. LOW POWER	1) HI/LOW SW: LOW	POWER.M panel			TX.RX	VR9	1.2W	Check that the meter lamp changes from to green.	
	2) MHz SW: 4	POWER.M						0.8 W～1.5 W	
	3) MHz SW: 7 100 kHz SW: 9 10 kHz SW: 9	POWER.M	rear panel	ANT.				0.8W～1.5W Power check output	Confirm

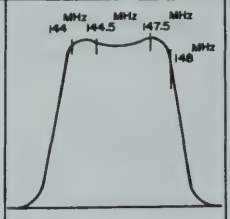
ADJUSTMENT

Item	Condition	Measuring point			Adjusting point			Reference	Remarks
		(Measure instruments)	Unit	Terminal	Unit	Parts	Method		
8. Output at the 11.5V (power supply)	1) DC Terminal: 11.5 V	POWER METER	rear panel	ANT.				Power check output	Confirm
	2) MHz SW: 6 10 kHz SW: 0 100 kHz SW: 0							Check power output	Confirm
	3) MHz SW: 4							Check power output	Confirm
	4) HI/LOW SW: HI							More than 6.0W	Confirm
	5) MHz SW: 6							More than 6.0W	Confirm
	6) MHz SW: 7 100 kHz SW: 9 10 kHz SW: 9							More than 6.0W	Confirm
9. Frequency SET	1) DC Terminal: 13.8V 2) MHz SW: 6 100 kHz SW: 0 10 kHz SW: 0	Frequency Counter	rear panel	ANT M coupling	TX.RX	TC1	146.000 MHz	±200 Hz	
10. Protection	1) Connect the Power Meter to the ANTENNA	DC V.M	TX.RX	TP4	TX.RX	VR5	MIN		
	2) Disconnect the Power to the ANTENNA TX.RX unit VR8: near centered	DC A.M	front panel		TX.RX	VR8	1.2A Check that the power is decrease when the power meter is disconnected.		
	3) MHz SW: 4	DC A.M						Approx. 1.2A	Confirm
	4) MHz SW: 7 100 kHz SW: 9 10 kHz SW: 9	DC A.M					Approx. 1.2A	Approx. 1.2A	Confirm
	5) Connect the power meter to the ANTENNA.	POWER.M	rear panel	ANT.				Power output go on again.	Confirm
11. Deviation	1) MHz SW: 6 100 kHz SW: 0 10 kHz SW: 0 AG OUTPUT: 30 mV/ 1 kHz	Linear Detector			TX.RX	VR2	5.0 kHz		
	2) AG OUTPUT: 3 mV/ 1 kHz	Linear Detector			TX.RX	VR1	3.5 kHz		
12. SUBTONE	1) MIC Terminal: OPEN SEND/REC. SW: SEND AG OUTPUT: 300 mV/ 1 kHz SUBTONE SW: ON	Linear Detector		SUB G >AG TB...DC V.M				1) Check that output waveform from the Linear Detector 2) Confirm that TV Terminal Voltage is approx. 10V.	Confirm
13. Abnormal Oscillation	1) Same as above 2) HI/LOW SW: LOW 3) MHz SW: 4 4) HI/LOW SW: HI 5) MHz SW: 7 100 kHz SW: 9 10 kHz SW: 9 6) HI/LOW SW: LOW	Linear Detector						Very the power voltage from 11.5 to 16 V for each item to check for abnormal oscillation	
14. Shift & Memory Shift	1) MHz SW: 5 100 kHz SW: 0 10 kHz SW: 0 5 kHz SW: 0 HI/LOW SW: HI DC terminal: 13.8V MODE SW: ⊖ SEND/REC. SW: SEND MR SW: OFF	F.Count	rear panel	ANT. M coupling				144.400 MHz	
	2) MODE SW: ⊕	F.Count	rear panel	ANT.				145.000 MHz	Confirm
	3) MHz SW: 7 MODE SW: ⊖	F.Count	rear panel	ANT.				146.400 MHz	Confirm
	4) MODE SW: ⊕	F.Count	rear panel	ANT.				147.600 MHz	Confirm
	5) MODE SW: S M SW (NON-LOCK): ON								Confirm

ADJUSTMENT

Item	Condition	Measuring point			Adjusting point			Reference	Remarks
		(Measure instruments)	Unit	Terminal	Unit	Parts	Method		
	6) MHz SW: 4 MODE SW: M (green)	F.Count	rear panel	ANT.				147.000 MHz Check that indication "7,000".	Confirm
	7) MODE SW: S	F.Count	rear panel	ANT.				144.000 MHz	Confirm
	8) MR SW: ON	F.Count	rear panel	ANT.				147.000 MHz Check that indication "7,000".	Confirm
15. Paint lock	1) L10, L11, L12, L13								

3. Adjustment of Receiver section

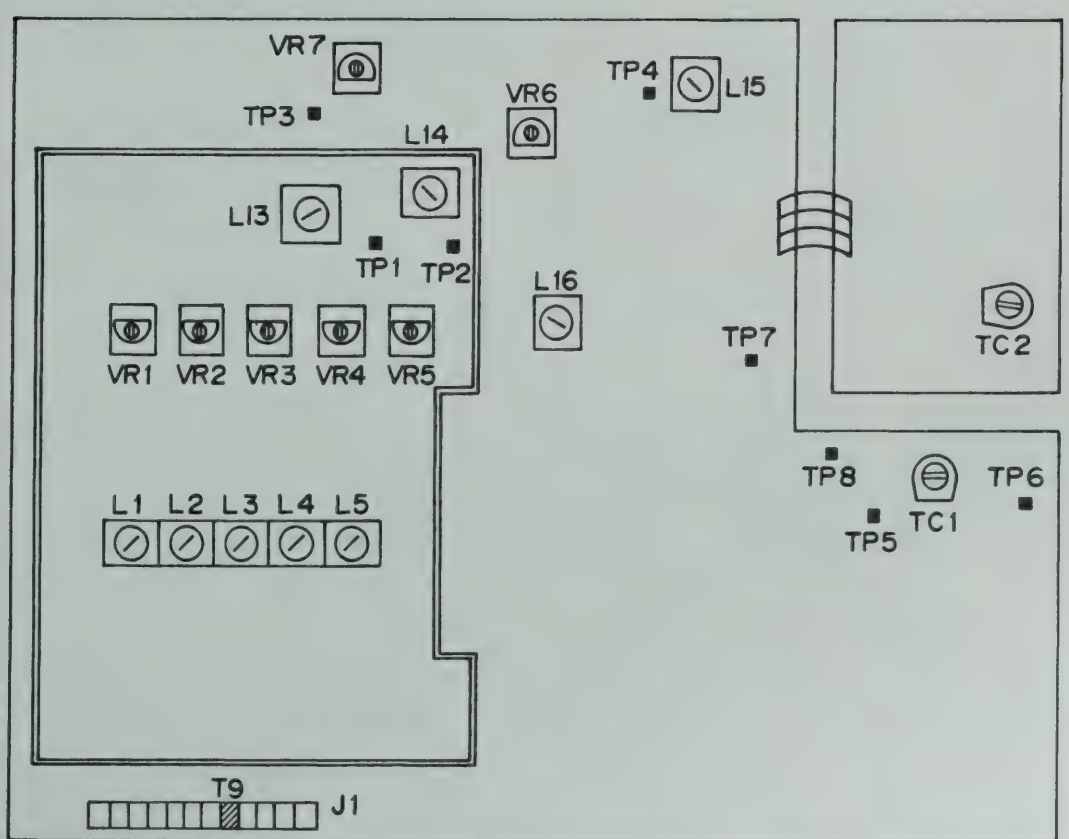
Item	Condition	Measuring point			Adjusting point			Reference	Remarks
		(Measure instruments)	Unit	Terminal	Unit	Parts	Method		
1. SETTING	1) POWER SW: ON HI/LOW SW: LOW MR SW: OFF MODE SW: S MHz SW: 5 100 kHz SW: 9 10 kHz SW: 5 5 kHz SW: 0 SUBTONE SW: OFF REMOTE SW: ON SEND/REC. SW: REC. SQUELCH VR: MIN EXT SP (terminal): AF V.M (8Ω) Oscilloscope								
2. Herical block	1) ANT terminal: SWEEP Oscilloscope VERT.GAIN: MAX	Oscillo- scope (Detector)	TX.RX	TP5	TX.RX	L29,30 L31 L32 (abc) (L33)	Adjust for a maximum gain and for a waveform as shown at right. Adjust L29 and L30 for a maximum waveform. Adjust L31, L32 (a.b.c) and L33 for a proper bandwidth and optimum waveform.	 Adjust L29 and L30 the waveform is distroted as shown below. 	Repeat
3. IF GAIN	1) REMOTE SW: OFF ANT UNIT: SSG (DEV.: 5 kHz. MOD.: 1 KHz SSG OUTPUT: Approx. 10 dB AF VR: 0.63 V/8Ω	AF V.M					Adjust SSG for correct frequency and set it to optimum waveform.		
	2) SSG OUTPUT: 5～10 dB	S METER			TX.RX	L34,35 L37	MAX. Repeat the same procedure two or three times.		
4 S METER	1) SSG OUTPUT: 30 dB	S METER			TX.RX	VR7	Set the scale 10 (30 V)	30 dB±4 dB	
5. Discriminator	1) SSG OUTPUT: 0 dB	AF V.M			TX.RX	L43	MAX		

ADJUSTMENT/PC BOARD ALIGNMENT

Item	Condition	Measuring point			Adjusting point			Reference	Remarks
		(Measure instruments)	Unit	Terminal	Unit	Parts	Method		
6. S/N (Signal to Noise ratio)	1) SSG OUTPUT: −6 dB 2) MHz SW: 4 100 kHz SW: 0 10 kHz SW: 0	AF V.M					With a signal received at each channel, set AF V.M to 0.63 V/8 . Next turn the SSG modulation OFF and measure the attenuation by AF V.M.	S/N 20 dB	Confirm
	3) MHz SW: 7 100 kHz SW: 9 10 kHz SW: 9	AF V.M					With a signal received, set AF V.M to 0.63V/8Ω. Next, turn the SSG modulation by AF V.M.	S/N 20 dB	Confirm
	4) MHz SW: 5 10 kHz SW: 9 SSG OUTPUT: 40 dB	AF V.M					With a signal received, set AF V.M to 0.63V/8Ω. Next, turn the SSG modulation OFF and measure the attenuation by AF V.M.	S/N 40 dB	Confirm
7. SQUELCH	1) SSG OUTPUT: OFF SQV. VR: Critical point	Oscilloscope (or SP)						Critical point 9:00～11:00	Confirm
	2) SSG OUTPUT: −8 dB SQU. VR: Position of item (1)	Oscilloscope (or SP)						When a signal of −8 dB is applied from the SSG, the squelch should open.	Confirm

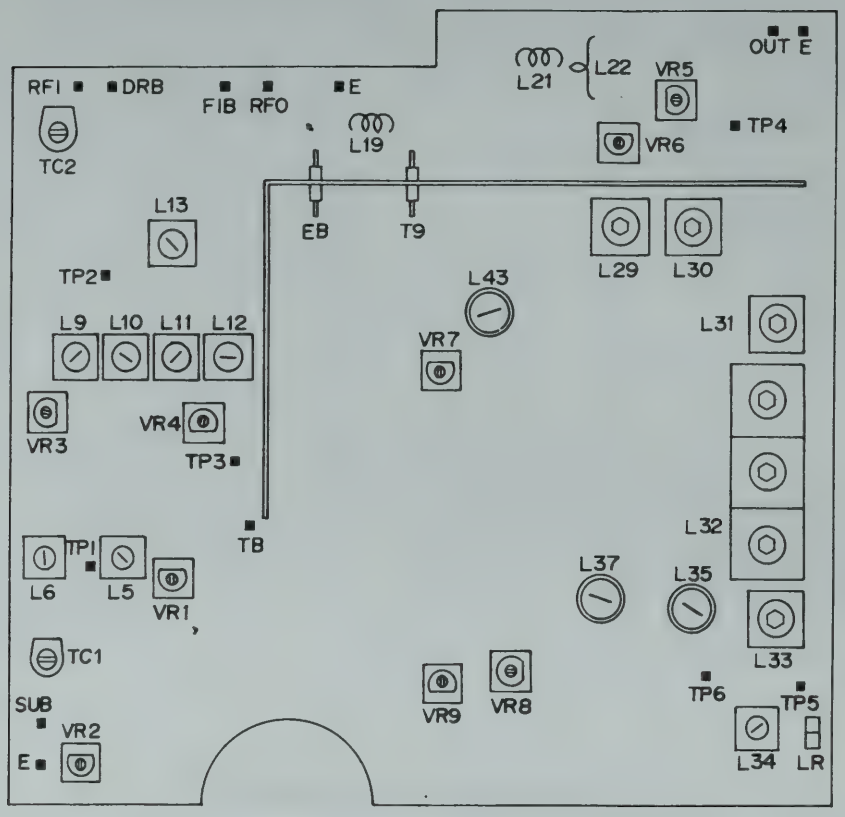
PC BOARD ALIGNMENT

PLL Unit (X50-1380-10)

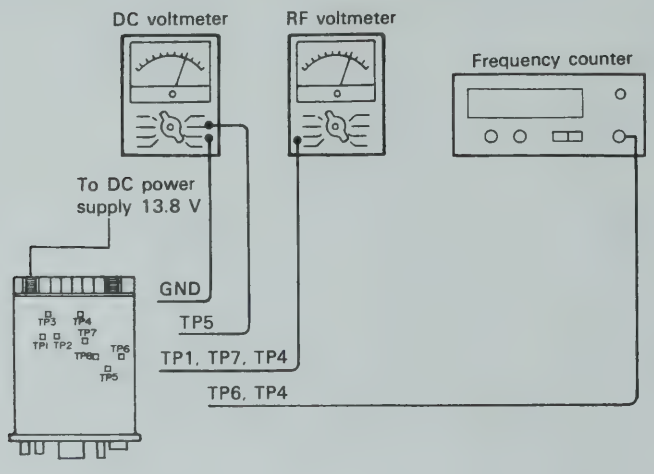


PC BOARD ALIGNMENT

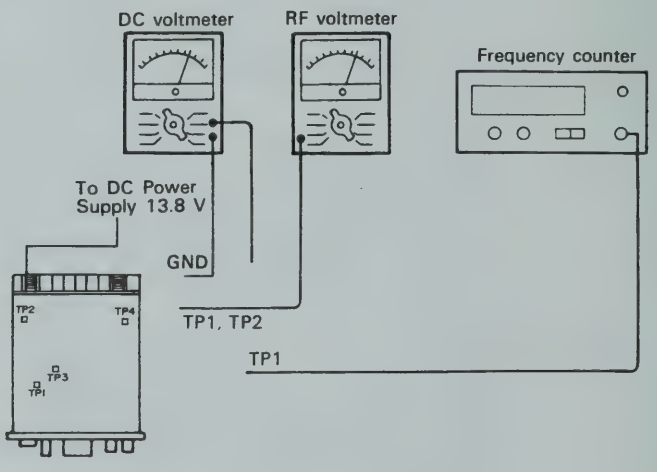
TX, RX Unit (X44-1300-10)



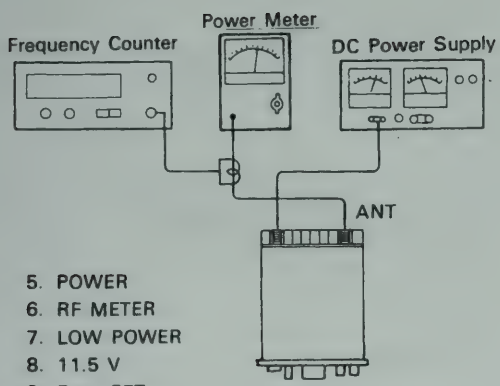
1. Adjustment of PLL Block



2. Tx Section adjustment

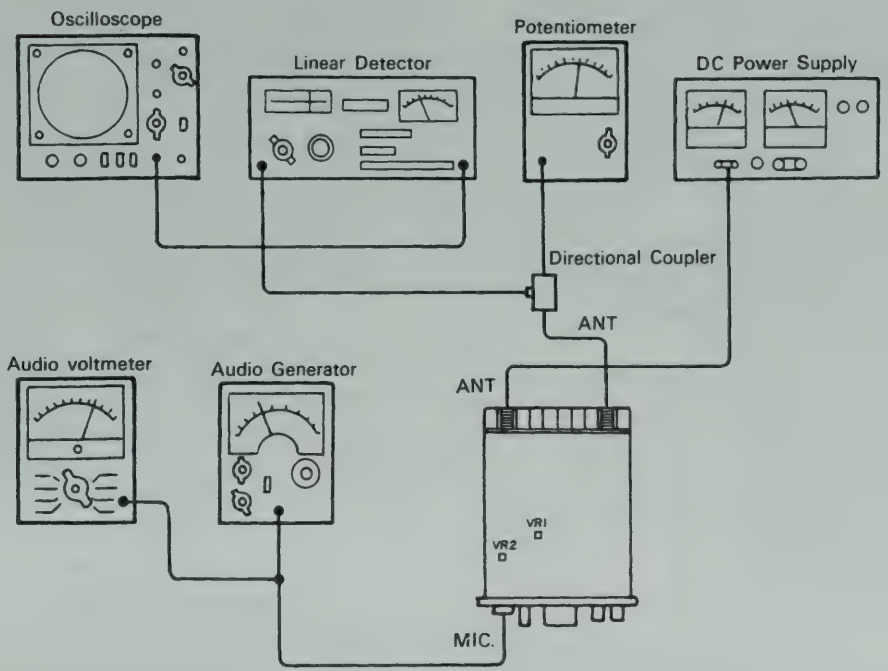


PC BOARD ALIGNMENT

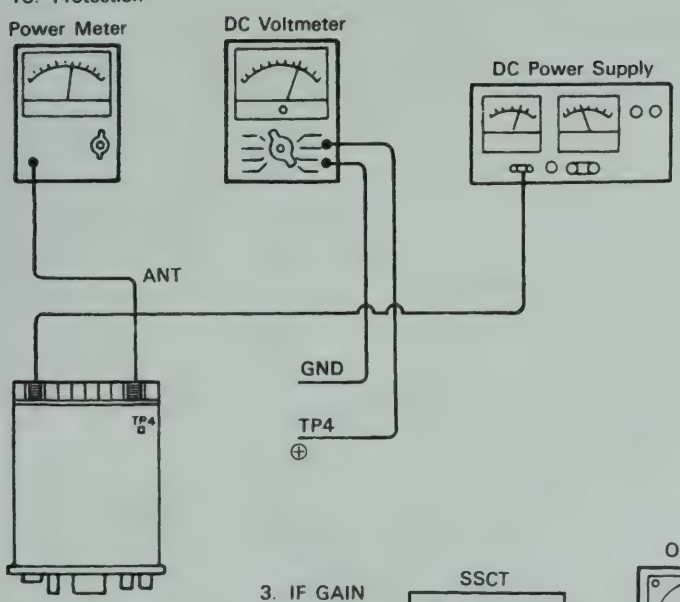


5. POWER
6. RF METER
7. LOW POWER
8. 11.5 V
9. Freq. SET
13. SHIFT AND MEMORY SHIFT

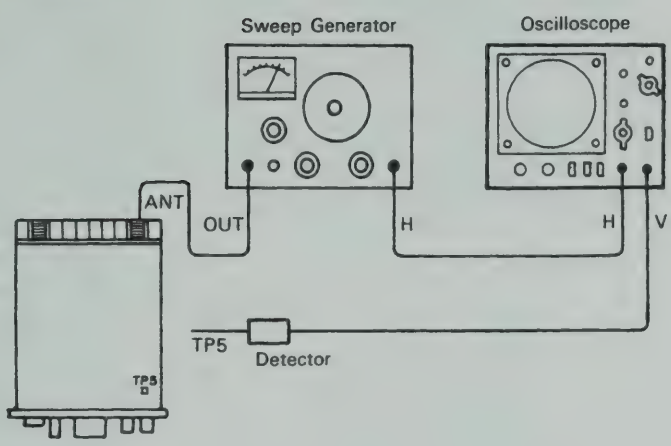
11. DEVIATION
12. ABNORMAL OSCILLATION



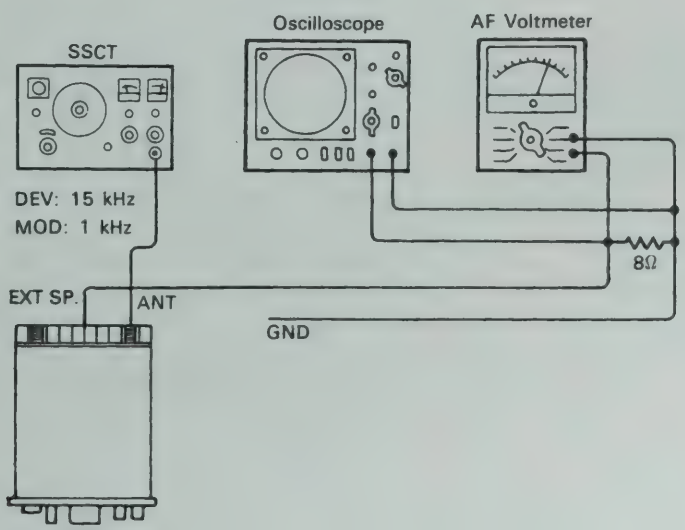
10. Protection



2. Helical



3. IF GAIN
4. S METER
5. Discretion
6. S/N
7. SQUELCH



SPECIFICATIONS

GENERAL

Semiconductors:	Transistors: 53 FETs: 9 ICs: 17 Diodes: 85
Frequency Range:	144.00 to 147.995 MHz
Frequency Synthesizer:	Digital control of phase locked VCO
Synthesizer Stability:	Less than ±750 Hz at 25°C
Mode:	FM
No. of Channels:	800
Operating Temperature:	−20 to +50°C
Power Voltage:	11.5V DC to 16.0V DC (13.8V DC standard)
Grounding:	Negative grounding
Antenna Impedance:	50Ω
DC Current:	Less than 0.5A in receive with no input signal Less than 3A in HI transmit (at 13.8V DC)
Dimensions:	161 mm (6-5/16″) wide 61 mm (2-3/8″) high 230 mm (9-1/16″) deep
Weight:	1.75 kg (3.85 lbs) Approx.

TRANSMITTER SECTION

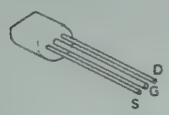
RF Output Power:	High: 10 watts (min.) Low: 1 watts approx. (adjustable to 10 watts)
Modulation:	Variable reactance direct shift
Max. Frequency Deviation:	±5 kHz
Spurious Radiation:	Less than −60 dB
Touch Tone Input Impedance:	600Ω
Microphone:	Dynamic microphone with PTT switch, 500Ω

RECEIVER SECTION

Circuitry:	Double superheterodyne
Intermediate Frequency:	1st: IF 10.7 MHz 2nd: IF 455 kHz
Sensitivity:	Less than 0.4 μV for 20 dB quieting (Less than 1 μV for 30 dB S/N)
Squelch Sensitivity:	Less than 0.25 μV
Pass Band Width:	More than 12 kHz at 6 dB down
Selectivity (2 Signal):	More than 76 dB at 30 kHz of adjacent channel
Image Rejection:	More than 70 dB
Spurious Interference:	More than 60 dB
Intermodulation:	More than 66 dB
Audio Output:	More than 1.5 watts across 8Ω load (10% distortion)

NOTE: The circuit and ratings may change without notice due to developments in technology.

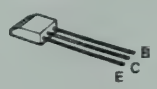
2SK30A(GR)



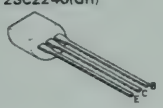
2SA496(Y)

2SK19(GR)

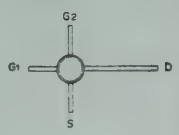
2SC460(B)



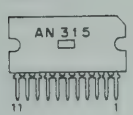
2SA1015(Y)
2SC1345(E)
2SC1815(Y)
2SC1923(O)
2SC1959(Y)
2SC2240(GR)



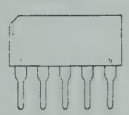
3SK74(L)



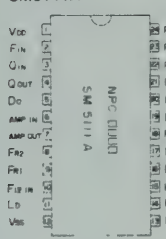
AN315



TA7060P

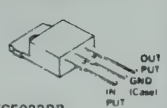


SM5111A



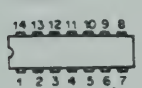
2SA1015(Y)
2SC1815(Y)

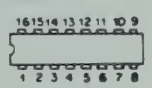
FS-7806M



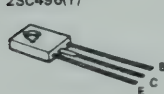
TC5022BP
TC4019BP
TC4035BP

TC4081P





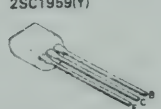
2SA496(Y)
2SC496(Y)



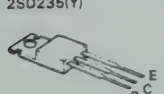
2SK19(GR)

2SC460(B)

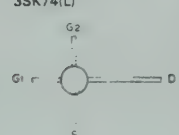
2SA1015(Y)
2SC1815(Y)
2SC1959(Y)



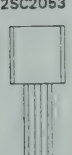
2SD235(Y)



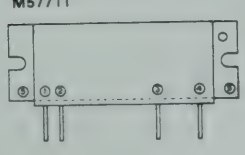
3SK74(L)

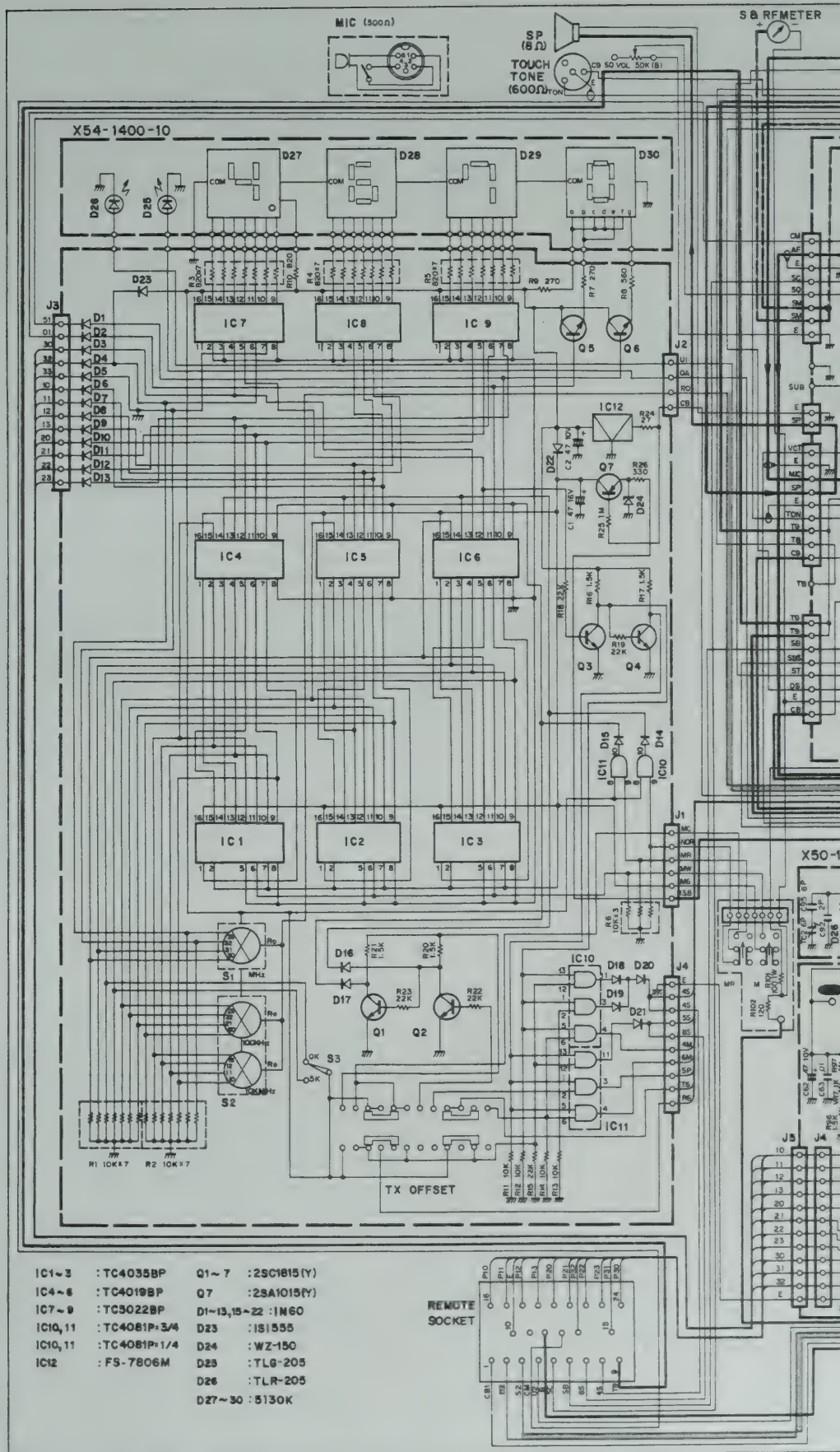


2SC2053



M57711





IC1~3	:TC4035BP	Q1~7	:2SC1815(Y)
IC4~6	:TC4019BP	Q7	:2SA1015(Y)
IC7~9	:TC5022BP	D1~13,15~22	:1N60
IC10,11	:TC4081P×3/4	D23	:1S1555
IC10,11	:TC4081P×1/4	D24	:WZ-150
IC12	:FS-7806M	D25	:TLG-205
		D26	:TLR-205
		D27~30	:5130K

① RFI, ② DRB, ③ FIB, ④ RFO.

SPECIFICATIONS

GENERAL

Semiconductors:	Transistors: 53 FETs: 9 ICs: 17 Diodes: 85
Frequency Range:	144.00 to 147.995 MHz
Frequency Synthesizer:	Digital control of phase locked VCO
Synthesizer Stability:	Less than ±750 Hz at 25°C
Mode:	FM
No. of Channels:	800
Operating Temperature:	−20 to +50°C
Power Voltage:	11.5V DC to 16.0V DC (13.8V DC standard)
Grounding:	Negative grounding
Antenna Impedance:	50Ω
DC Current:	Less than 0.5A in receive with no input signal Less than 3A in HI transmit (at 13.8V DC)
Dimensions:	161 mm (6-5/16″) wide 61 mm (2-3/8″) high 230 mm (9-1/16″) deep
Weight:	1.75 kg (3.85 lbs) Approx.

TRANSMITTER SECTION

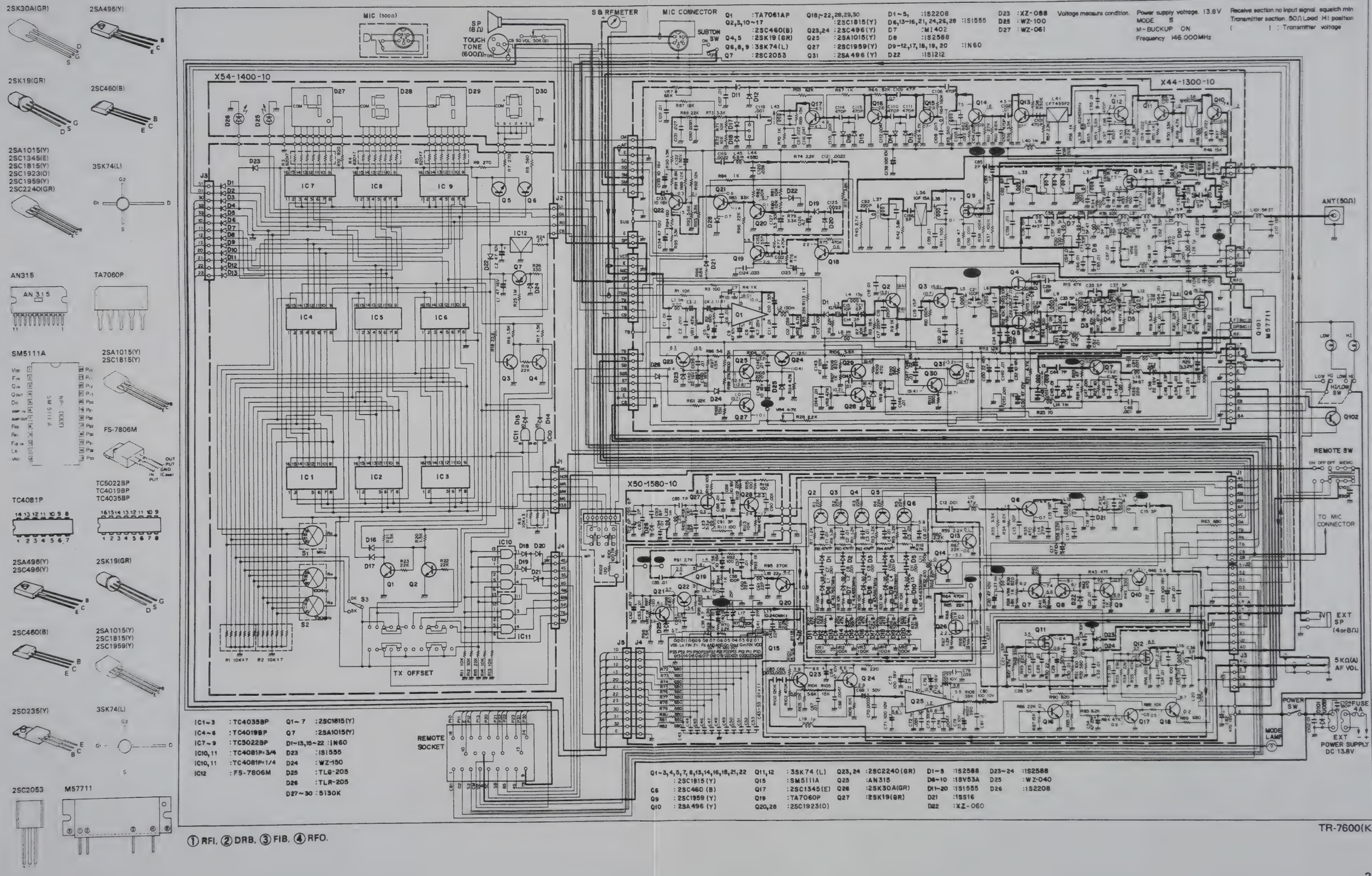
RF Output Power:	High: 10 watts (min.) Low: 1 watts approx. (adjustable to 10 watts)
Modulation:	Variable reactance direct shift
Max. Frequency Deviation:	±5 kHz
Spurious Radiation:	Less than −60 dB
Touch Tone Input Impedance:	600Ω
Microphone:	Dynamic microphone with PTT switch, 500Ω

RECEIVER SECTION

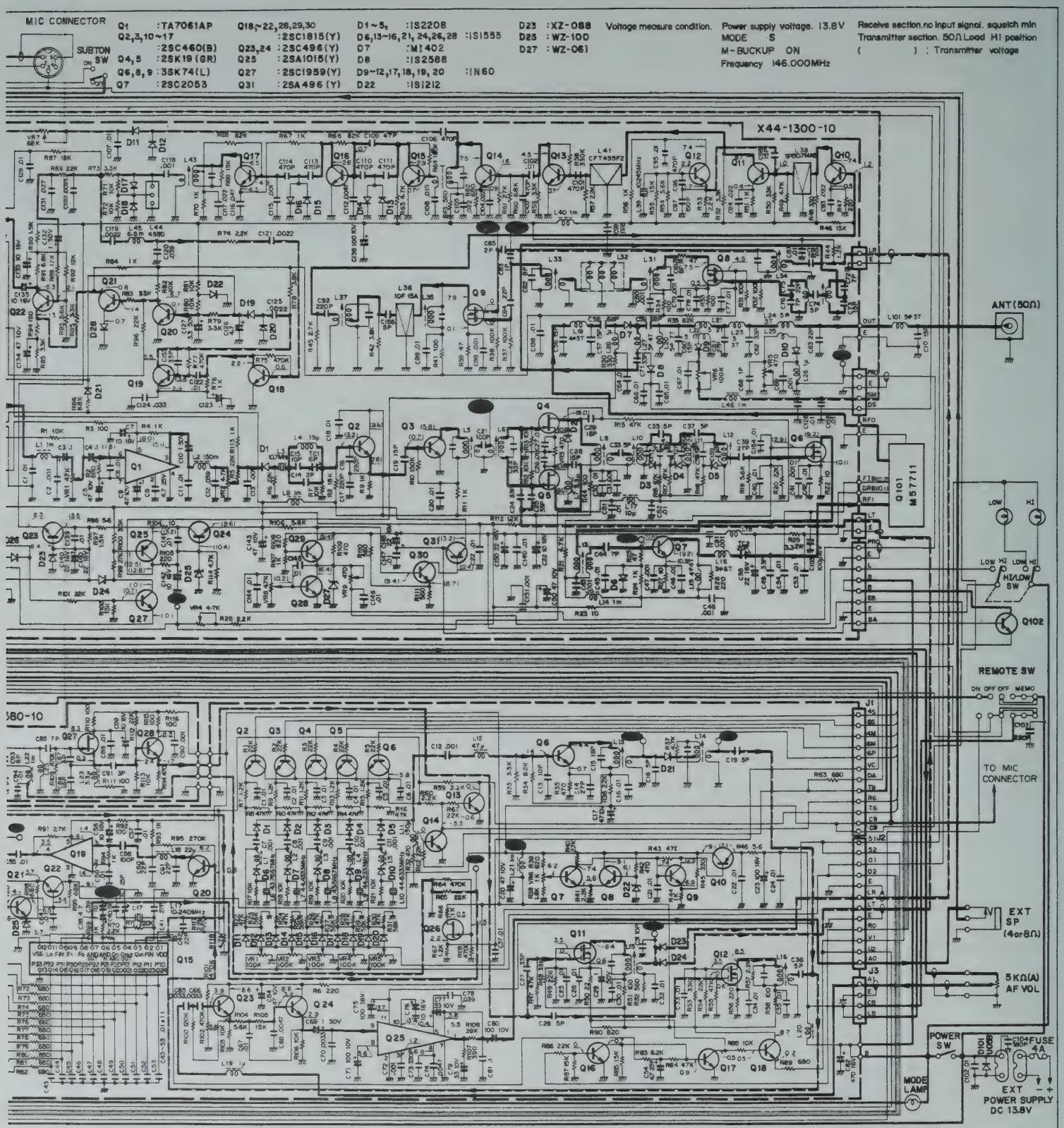
Circuitry:	Double superheterodyne
Intermediate Frequency:	1st: IF 10.7 MHz 2nd: IF 455 kHz
Sensitivity:	Less than 0.4 μV for 20 dB quieting (Less than 1 μV for 30 dB S/N)
Squelch Sensitivity:	Less than 0.25 μV
Pass Band Width:	More than 12 kHz at 6 dB down
Selectivity (2 Signal):	More than 76 dB at 30 kHz of adjacent channel
Image Rejection:	More than 70 dB
Spurious Interference:	More than 60 dB
Intermodulation:	More than 66 dB
Audio Output:	More than 1.5 watts across 8Ω load (10% distortion)

NOTE: The circuit and ratings may change without notice due to developments in technology.

SCHEMATIC DIAGRAM



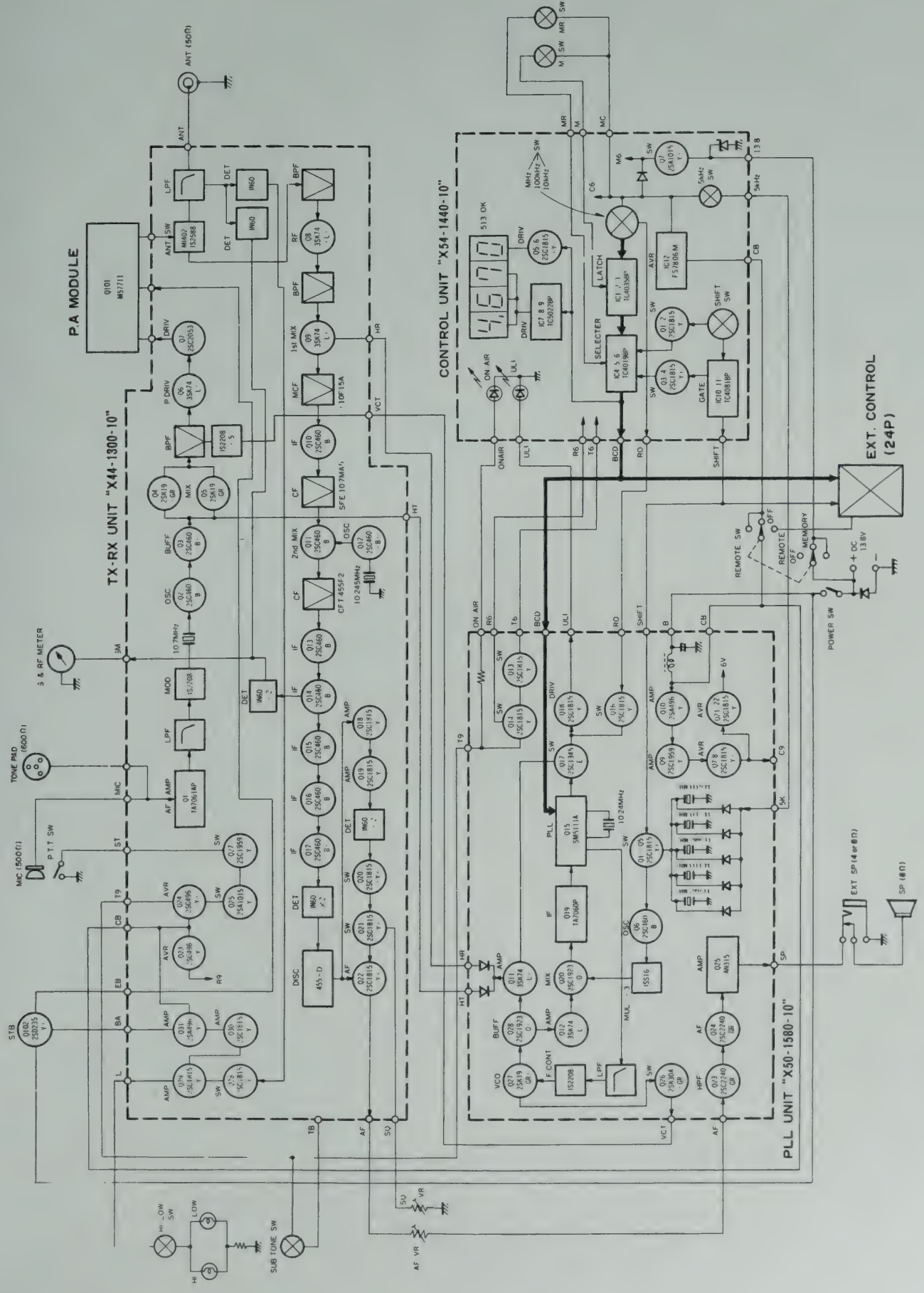
ATIC DIAGRAM



1~3,4,5,7,8,13,14,16,18,21,22	:2SC1815(Y)	Q11,12	:3SK74(L)	Q23,24	:2SC2240(GR)	D1~5	:1S2588
6	:2SC460(B)	Q15	:SM5111A	Q25	:AN315	D6~10	:1SV53A
9	:2SC1959(Y)	Q17	:2SC1345(E)	Q26	:2SK30A(GR)	D11~20	:1S1555
10	:2SA496(Y)	Q19	:TA7060P	Q27	:2SK19(GR)	D21	:1SS16
		Q20,28	:2SC1923(O)			D22	:XZ-060
						D23~24	:1S2588
						D25	:WZ-040
						D26	:1S2208

TR-7600(K)

BLOCK DIAGRAM



A product of
TRIO-KENWOOD CORPORATION
6-17, 3-chome, Aobadai, Meguro-ku, Tokyo 153, Japan

TRIO-KENWOOD COMMUNICATIONS, INC.
1111, West Walnut Street, Compton, California, 90220, U S A
TRIO-KENWOOD COMMUNICATIONS, GmbH
D 6374 Steinbach TS, Industriestrasse 8A, West Germany
TRIO-KENWOOD (AUSTRALIA) PTY. LTD.
30 Whiting Street, Artarmon, Sydney N S W, Australia 2064

1978-12 PRINTED IN JAPAN B51-0865-00 1000 (K)(W)(T) (G)

KENWOOD

SERVICE MANUAL

TR-7600

2m FM TRANSCEIVER

INDUCTION/CONTENTS

INTRODUCTION

Your KENWOOD Model TR-7600 is an advanced 2-meter transceiver for amateur mobile, and optional fixed station operation.

The TR-7600 features:

- ☆ Memory channel (simplex and repeater mode).
- ☆ Memory TX and ±600 kHz repeater TX for repeater operation.
- ☆ 800 channel PLL circuit.
- ☆ Digital frequency display.
- ☆ Dual concentic frequency selector switches.
- ☆ PLL UNLOCK and ON AIR indicators.
- ☆ Subaudible ON/OFF switch (Encoder user installed).
- ☆ Powered tone pad connector with 9V DC on one pin.
- ☆ Pin Mic connector with 9V DC on one pin.
- ☆ TX HI-LOW (Power) switch.

CONTENTS

GENERAL/CIRCUIT DESCRIPTION

GENERAL

The TR-7600 is a 10W, multi-channel (800 channels) FM transceiver covering 144 ~ 147.995 MHz. It features a built-in repeater shift circuit and memory circuit, and provision for connection of an option remote controller for operation with a micro-computer.

PLL CIRCUIT

The TR-7600 employs PLL circuit composed of IC SM5111A for programmable counter, reference oscillator, frequency divider and phase detector. Setting of frequency division ratio, frequency memory and remote indication functions are all controlled by BCD codes.

PLL CIRCUIT BLOCK DIAGRAM

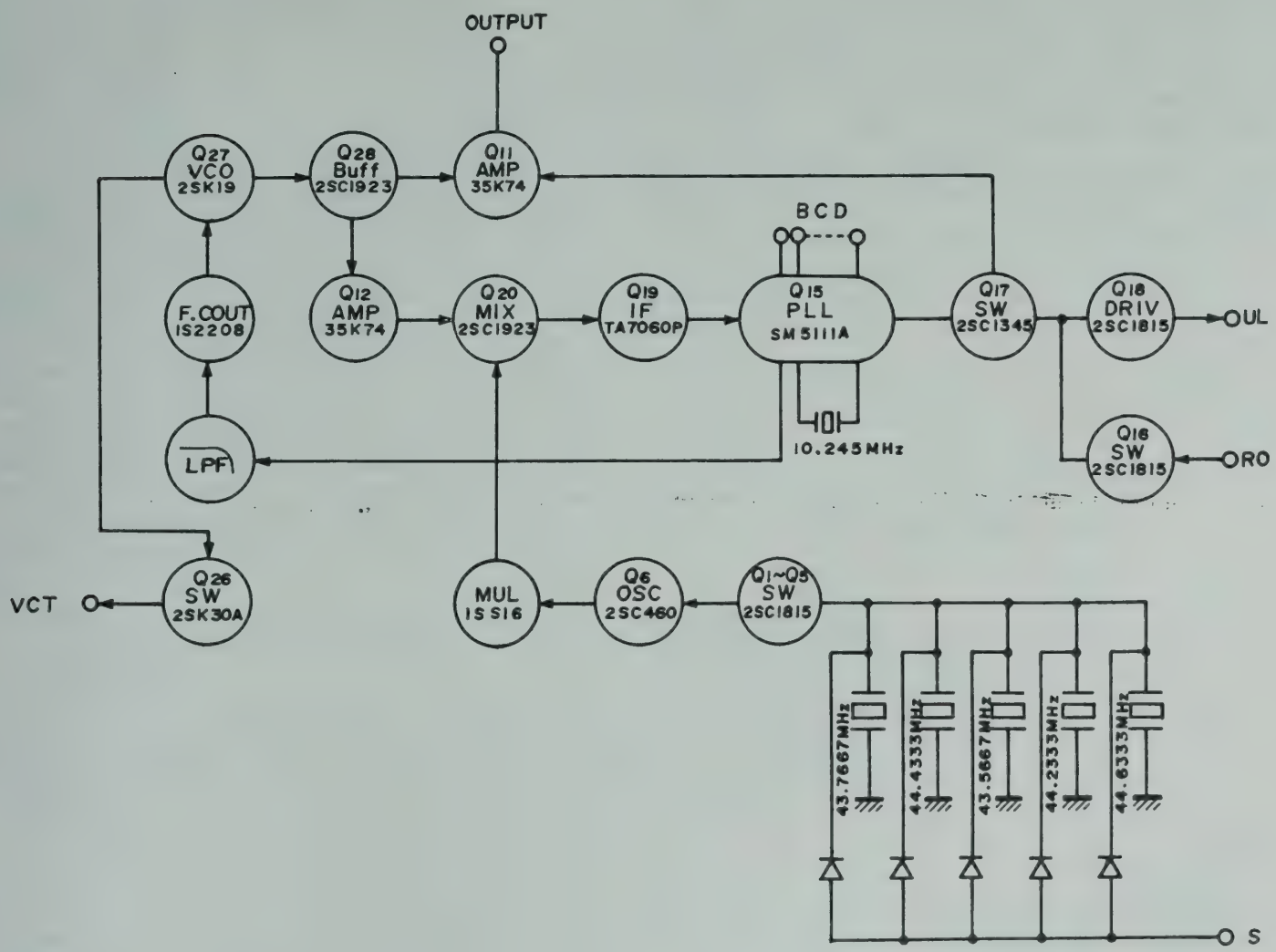


Fig. 1 PLL Circuit

CIRCUIT DESCRIPTION

1. Phase Locked Loop

The 130 MHz signal from Q27 passes through the buffer circuit Q28 and is then divided into a synthesizer output and a loop output by Q11 and Q12 respectively. The output from Q12 is mixed with the local oscillator output, trippled by Q6 and 1SS16, by Q20 to obtain IF frequency. The IF output is amplified by Q19 and is fed to Q15 where the output is frequency divided in the ratio specified by BCD code to compare it with the 10 kHz reference frequency (1/1024 of 10,240 MHz).

The DC output thus obtained passes through the low-pass filter to control the VCO vari-cap 1S2208. The output from Q26 controls the transmit frequency bandwidth. When the signal is unlocked, the output is shut off by Q17 which is indicated by Q18. Q16 is used to shut off the output when the rotary switch is between channel setting positions.

Rx Tx Freq.	Simplex Output	Division	Osc Xtal Freq.	IF Freq.
144.00 MHz	133.3 MHz	200	43.7667 MHz	2 MHz
145.00 MHz	134.3 MHz	300	43.7667 MHz	3 MHz
145.99 MHz	135.29 MHz	399	43.7667 MHz	3.99 MHz
146.00 MHz	135.3 MHz	200	44.4333 MHz	2 MHz
147.00 MHz	136.3 MHz	300	44.4333 MHz	3 MHz
147.99 MHz	137.29 MHz	399	44.4333 MHz	3.99 MHz

Table 1 Division and Frequency

2. +5 kHz Circuit

In the PLL circuit, the reference frequency is controlled in 10 kHz steps. The +5 kHz signal is controlled by varying the local oscillator crystal frequency with the vari-cap, so the frequency division remains unchanged even when the +5 kHz circuit is operated.

The memory circuit also includes the same bit and functions even when the +5 kHz circuit is operating.

3. Shift Circuit

Transmit frequencies can be shifted by changing the local oscillator crystal, as shown below.

144 and 145 MHz bands:

[−] shift	43.5667 MHz
[S]	43.7667 MHz

The [+] shift is not available for 144 and 145 MHz bands.

The [S] is obtained at the [+] position.

146 and 147 MHz Bands:

[−] shift	44.2333 MHz
[+] shift	44.6333 MHz
[S]	44.4333 MHz

4. Memory Shift Circuit

The memory shift circuit (MT) is a circuit to shift the memory input frequency during transmission. The function is the same as in [S].

CONTROL UNIT

Frequency settings are accomplished by the MHz, 100 kHz and 10 kHz rotary switches. The relationship between the frequency and frequency division is shown below.

Frequency	Frequency division
144.000 MHz	200
145.000 MHz	300
145.990 MHz	399
146.000 MHz	200
147.000 MHz	300
147.990 MHz	399

The local oscillator frequency of kHz order can be shifted by the switch. The frequency division set by the rotary switch is stored in the latch IC's 1, 2 and 3 by pressing the memory input switch. The output from the latch circuit is fed through IC's 4, 5 and 6 in the selector circuit to the PLL circuit by pressing the memory call switch. When this switch is not pressed, the output is directly fed to the PLL circuit. Memory function is effected by latching each switch. The information from each switch is stored by pressing the memory switch. The stored information remains the same unless the memory switch is pressed once again. Selection of memory output and rotary output is accomplished by the selector circuit. A latched output is obtained by pressing the memory output switch.

The signal to the PLL circuit passes through the LED driver circuit and is digitally indicated by LED (orange).

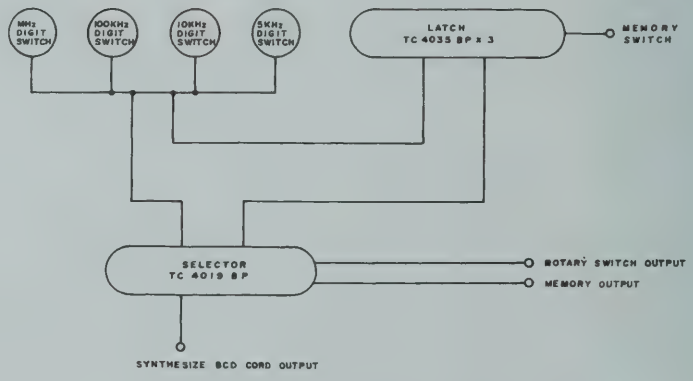


Fig. 2 Block Diagram of Frequency Memory Circuit

CIRCUIT DESCRIPTION

TRANSMITTER UNIT

The microphone signal passes through the limiter amplifier and is FM modulated by the 10.7 MHz oscillator. The signal is mixed with the local oscillator signal to obtain 144 ~ 146 MHz signal. The B.P.F. is of a variable type, providing excellent characteristics with respect to power and spurious even at the shift time because of the use of VCO voltage. The power stage uses the power module M5711 manufactured by the Mitsubishi Electric Co., to provide higher reliability.

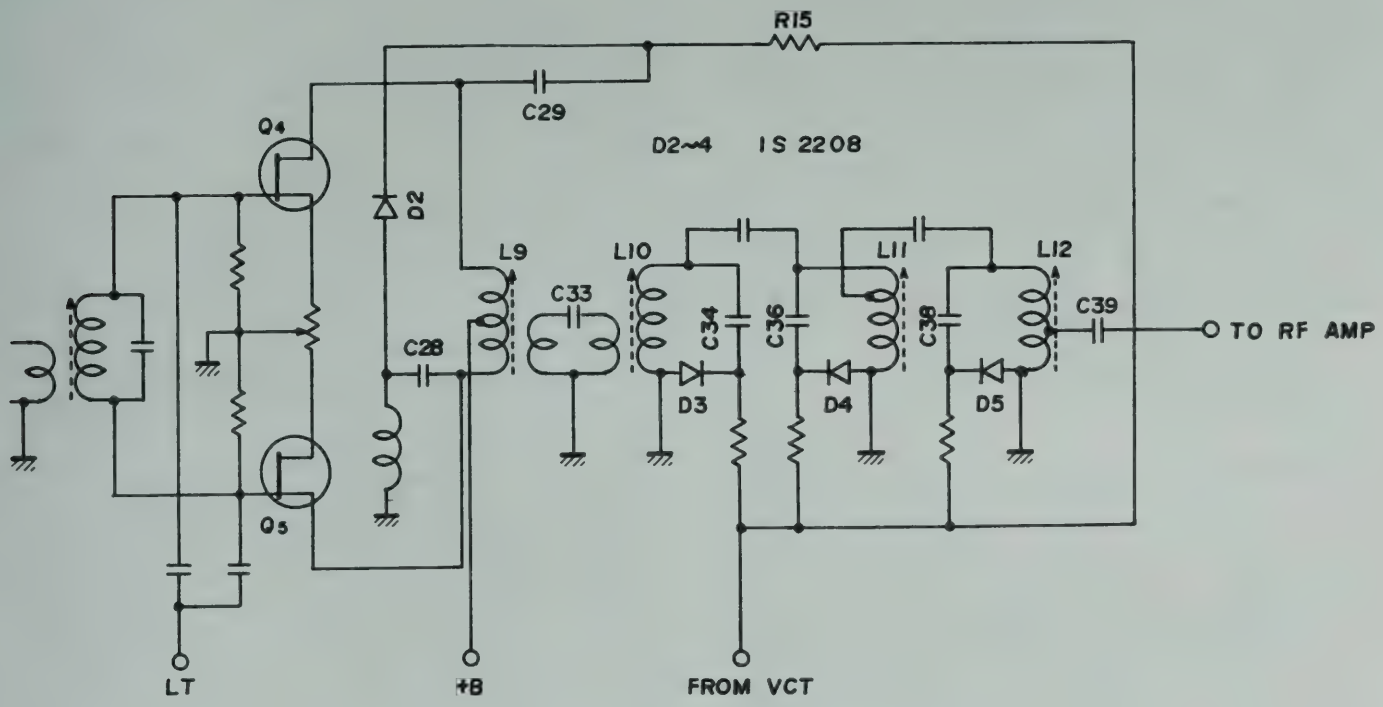


Fig. 3 Variable Band Width Control Circuit (for Transmission)

RECEIVER UNIT

The signal from the transmit/receive matching circuit passes through the diode switch and is fed to the 2-stage antenna tuning circuit, 3-stage merical tuning circuit and RF amplifier of MOS FET. This signal is further fed to the mixer circuit MOS FET where it is converted into 10.7 MHz signal. The signal thus converted passes through the 2-stage filter and is fed to the 2nd mixer where it is converted into 455 kHz signal. The 2nd IF signal from the 455 kHz ceramic filter passes through the limiter circuit where it is converted into AF signal by the ceramic discriminator. . This signal is amplified by the audio power amplifier to drive the speaker.
The receiver unit includes a noise amplification type squelch circuit. This circuit picks up the noise component in the squelch signal from the discriminator which is amplified and rectified to control the 1st stage AF amplifier.
The characteristic of the discriminator is opposite that of conventional ones to permit connection of a remote controller.

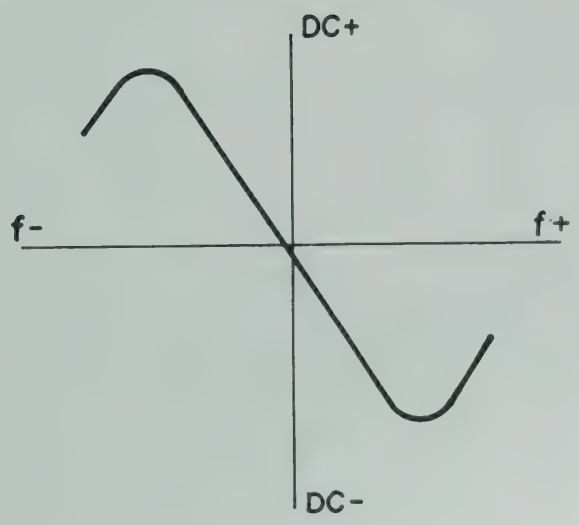


Fig. 4 Discriminator Characteristics

SM5111A

Electrostatic Breakdown Protection

This product has a built-in input protection circuit to prevent a gate breakdown due to static electricity.

In order to protect the input circuit from damage due to a large static electricity or voltage in excess of the limit permissible to the circuit, the following points should be observed:

1. When the product is not in use, keep all the terminals in contact with insulating material (this is done at the factory prior to shipment).
2. Soldering iron, testing instrument and other tools should be earthed while in use.
3. Do not insert or remove IC from the socket without turning off the power.
4. Do not apply signal voltage to the input terminal when the power is OFF.
5. Do not apply a voltage exceeding the power voltage to the input terminal.

OPERATING SYSTEM

This product has been developed as C-MOS LSI used for PLL circuit. As shown in the block diagram in Fig. 1, it consists of OSC: reference oscillator circuit, DIVIDER: reference frequency dividing circuit, PC: programmable counter, PD: phase comparator, and INV: inverter. A high accuracy feedback type crystal oscillator circuit can be formed by adding a crystal oscillating element, resistor and capacitor between the QIN and QOUT terminals of the reference oscillator circuit. This also permits an external signal to be fed to the QIN terminal.

The oscillator output is applied to the reference frequency dividing circuit where it is divided into the desired frequencies of fr1 (1/2028) and fr2 (1/1024) which are the reference signals of the digital type phase comparator on the next stage.

The comparison signal (frequency f1) fed to the input terminal FIN of the AMP is amplified and wave shaped, then fed to the input of the programmable counter. The frequency "f1" is frequency converted (fpc) through the program terminals P01 ... P33 (for example, when P01 ... P33 = 1, the programmable counter output is 1/999), and is fed to the phase comparator where the reference signal is compared with the comparison signal in phase so that a pulse signal, shown below, proportional to the phase difference in two signals is fed to the output terminal DO.

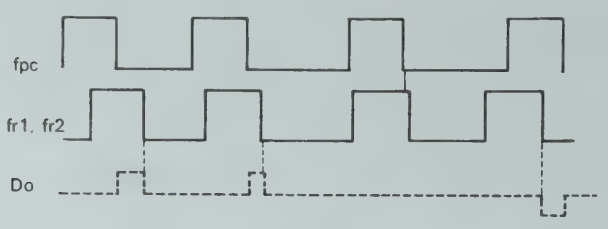


Fig. 5

The table below shows the maximum limits of operating conditions and environmental conditions. If any of these values exceeds the given limits, it can be a cause of damage to the product or deterioration of quality.

Item	Symbol	Rating	Unit
Power Supply Voltage	DDV -VSS	−0.3 ~ +7.5	V
Input Voltage	VIN	VSS ≦ VIN ≦ VDD	V
Operating Temperature	TA	−30 ~ +70	°C
Storage Temperature	TSTG	−40 ~ +125	°C
Power Consumption	PD	250	mW
Soldering Temperature		260	°C
Soldering Time		5	sec

Table 2 SM5111A Absolute Maximum Ratings

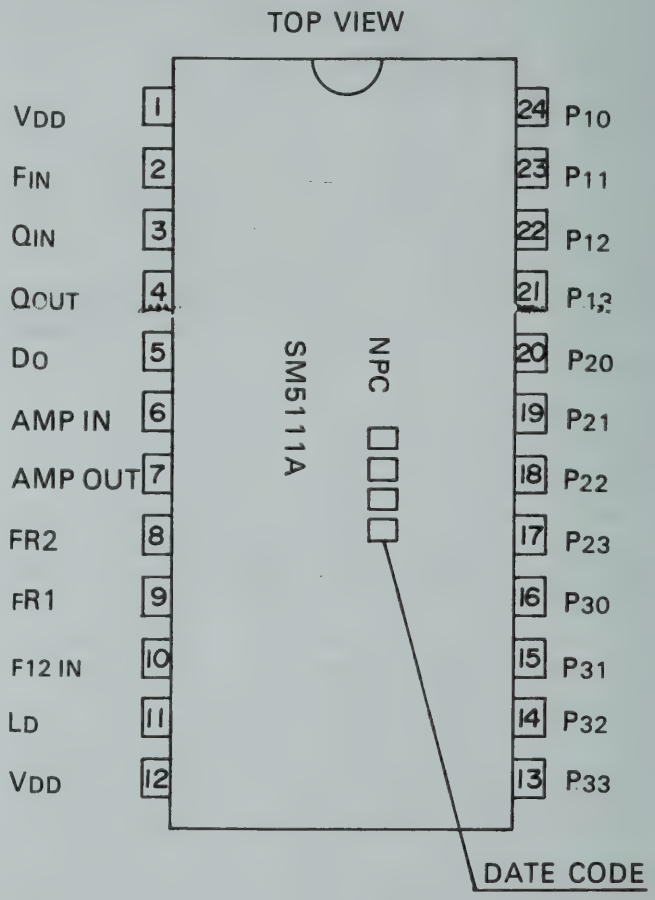


Fig. 6 SM5111A Pin Arrangement

3SK74

SPECIFICATIONS

Application	VHF RF Amplifier (Mixer)	
Construction	N-Channel • MOS FET (Dual Gate)	
Drain • Source Voltage	V_{DSX}	20V
Gate 1 • Source Voltage	V_{G1S}	±10V
Gate 2 • Source Voltage	V_{G2S}	±10V
Drain Current	I_D	25 mA
Allowable Loss	P_T	200 mW
Channel Temperature	T_{CH}	125°C
Storage Temperature	T_{STG}	−5.5 ~ +125°C

Maximum Specifications

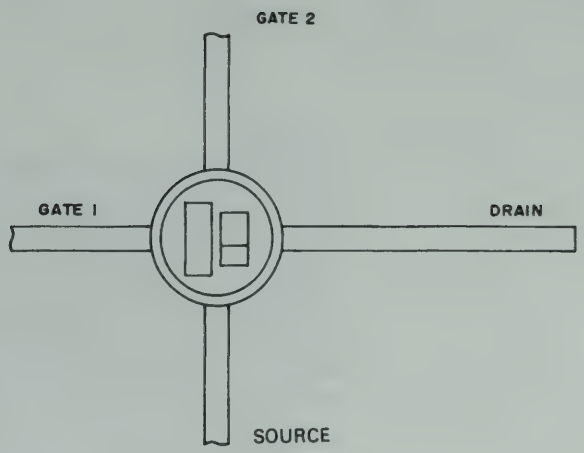


Fig. 7 3SK74 Outlines

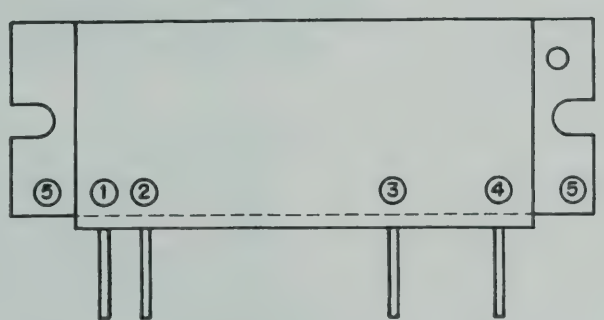
TEST CONDITION

Item	Code	Condition
Drain • Source Voltage	V_{DSX}	V_{G1S} = −3V, V_{G2S} = 3V, I_D = 500nA
Drain Current	I_{DSS}	V_{DS} = 6V, V_{G1S} = 0, V_{G2S} = 3V
Cut-Off Voltage (Gate 1)	V_{G1S}	V_{DS} = 6V, V_{G2S} = 0, I_D = 500nA
Cut-Off Voltage (Gate 2)	V_{G2S}	V_{DS} = 6V, V_{G1S} = 0, I_D = 500nA
Gate Leak Current (Gate 1)	I_{G1SS}	V_{DS} = 0, V_{G1S} = ±10V, V_{G2S} = 0
Gate Leak Current (Gate 2)	I_{G2SS}	V_{DS} = 0, V_{G1S} = 0, V_{G2S} = ±10V
Small Signal Transfer Admittance	$\|y_{fs}\|$	V_{DS} = 6V, V_{G2S} = 3V, I_D = 10mA, f = 1.0 kHz
Small Signal Input Capacity	C_{iss}	V_{DS} = 6V, V_{G2S} = 3V, I_D = 10mA, f = 1.0 MHz
Small Signal Output Capacity	C_{oss}	V_{DS} = 6V, V_{G2S} = 3V, I_D = 10mA, f = 1.0 MHz
Small Signal Feedback Capacity	C_{rss}	V_{DS} = 6V, V_{G2S} = 3V, I_D = 10mA, f = 1.0 MHz
Output Power Gain	G_P	V_{DD} = 10V, I_D = 10mA, f = 200 MHz
Noise Figure	NF	V_{DD} = 10V, I_D = 10mA, f = 200 MHz

Maximum Rating of M57711

(TA = 25°C, unless otherwise noted)

Item	Symbol	Condition	Value	Unit
Operating Voltage	V_{CC}		17	V
DC Current	I_{CC}		5	A
Operating Temperature	$T_{C(OP)}$		−30 ~ +110	°C
Storage	T_{STG}		−30 ~ +110	°C



1. Input Terminal (RFI)
2. Power Supply of Drive Stage (DRB)
3. Power Supply of Output Stage (FIB)
4. Output Terminal (RFO)
5. GND

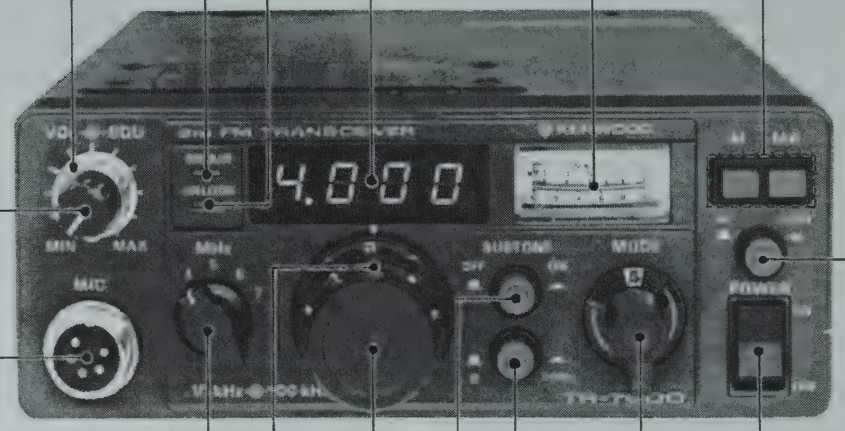
Fig. 8 M57711 Outlines

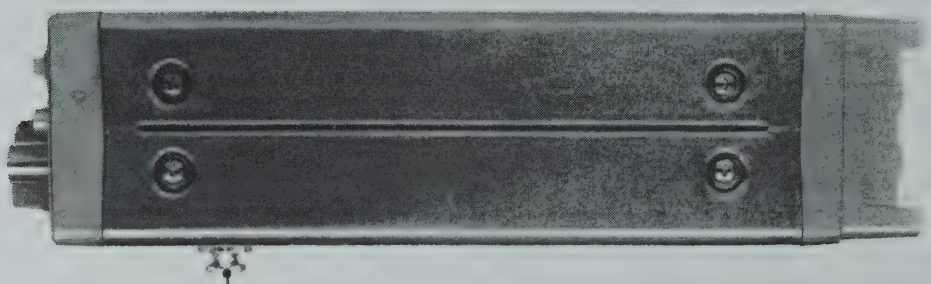
Electrical Characteristic of M57711

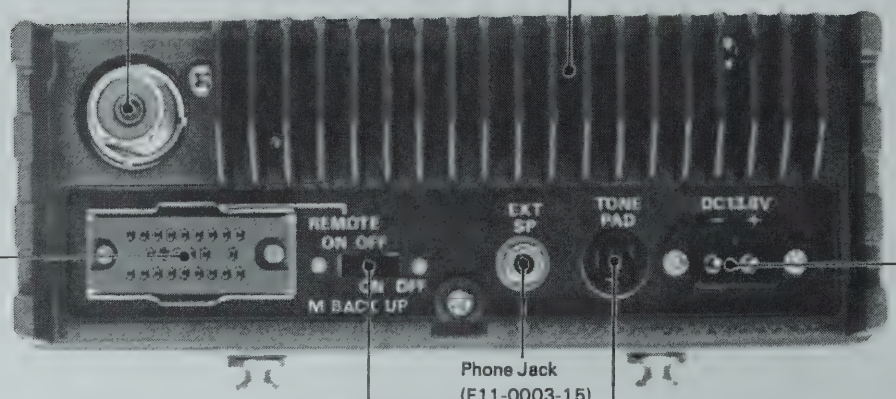
(TA = 25°C unless otherwise noted)

Item	Symbol	Condition	Value			Unit
			Min.	Std.	Max.	
Output Power	P_O	f = 144~148 MHz, V_{CC} = 12V Pin = 0.15W, Z_G = Z_L = 50Ω	14	16		W
Total Efficiency	S_T	f = 144~148 MHz, V_{CC} = 12V Pin = 0.15W, Z_G = Z_L = 50Ω	53	58		%
2nd Harmonic Radiation		f = 144~148 MHz, V_{CC} = 12V Pin = 0.15W, Z_G = Z_L = 50Ω			−25	dB
More than 3rd Harmonic Radiation		f = 144~148 MHz, V_{CC} = 12V Pin = 0.15W, Z_G = Z_L = 50Ω			−35	dB
Input VSWR	P_{IN}	f = 144~148 MHz, V_{CC} = 12V Pin = 0.15W, Z_G = Z_L = 50Ω		2.5	2.8	
Output VSWR	P_{OUT}	f = 144~148 MHz, V_{CC} = 12V Pin = 0.15W, Z_G = Z_L = 50Ω		1.3	1.5	
Impedance		Note	∞ : 1			

PANEL CONTROLS

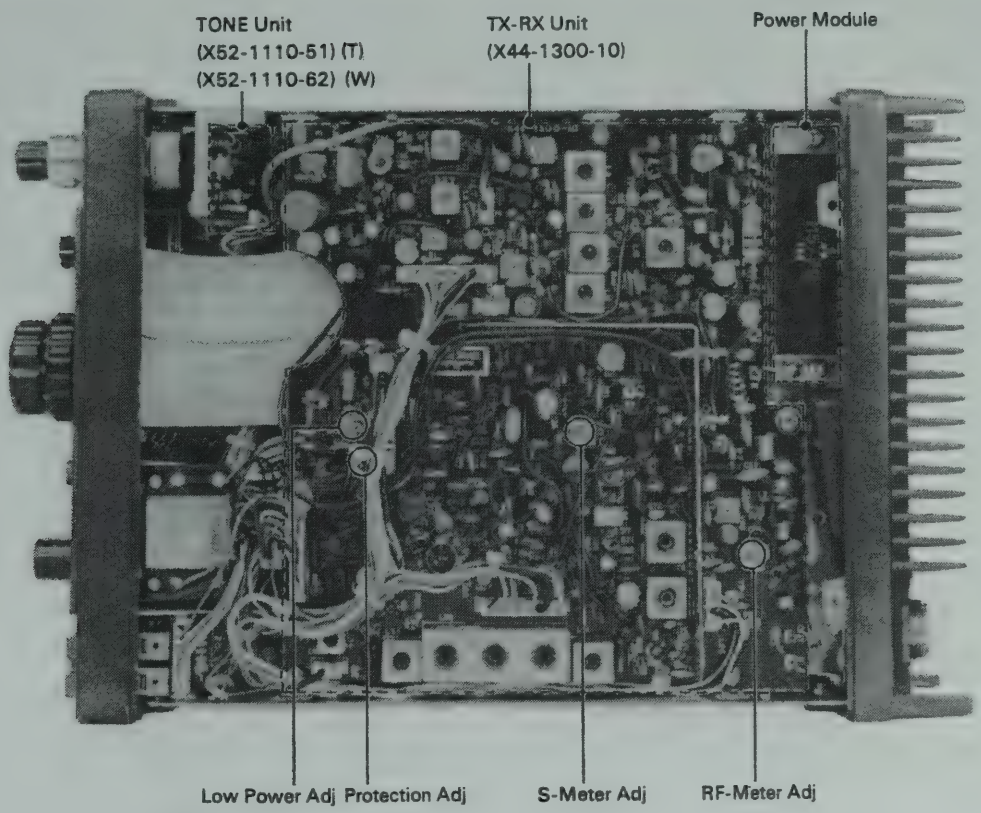




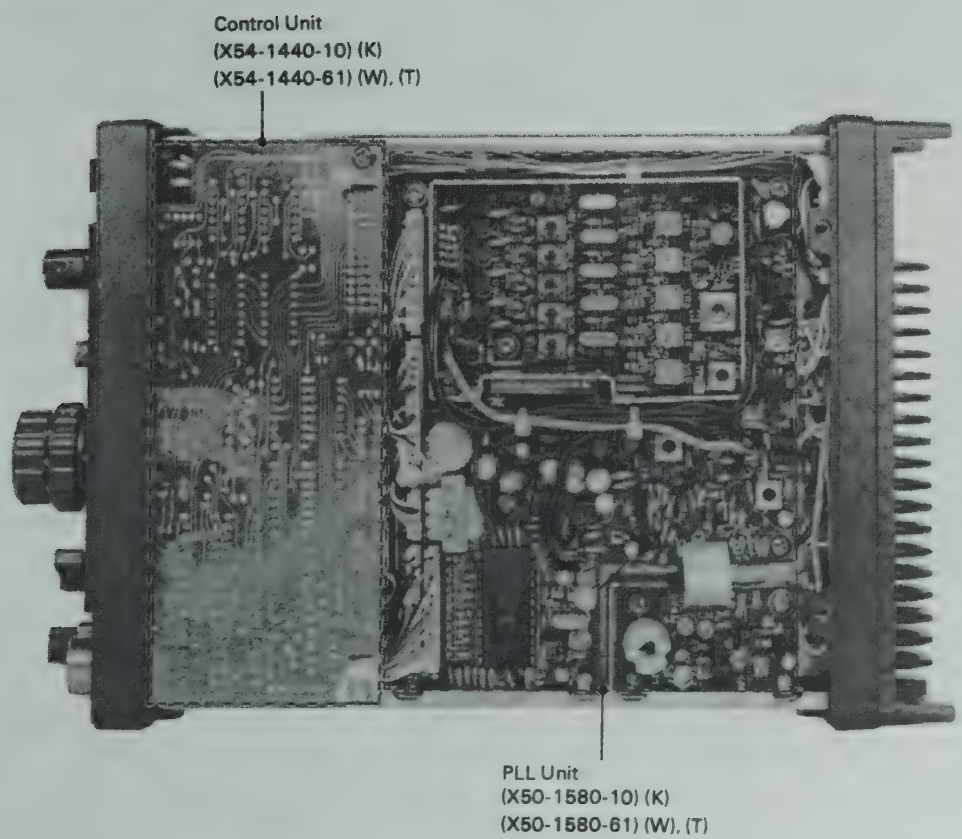


PARTS ALIGNMENT

VIEWED FROM TOP

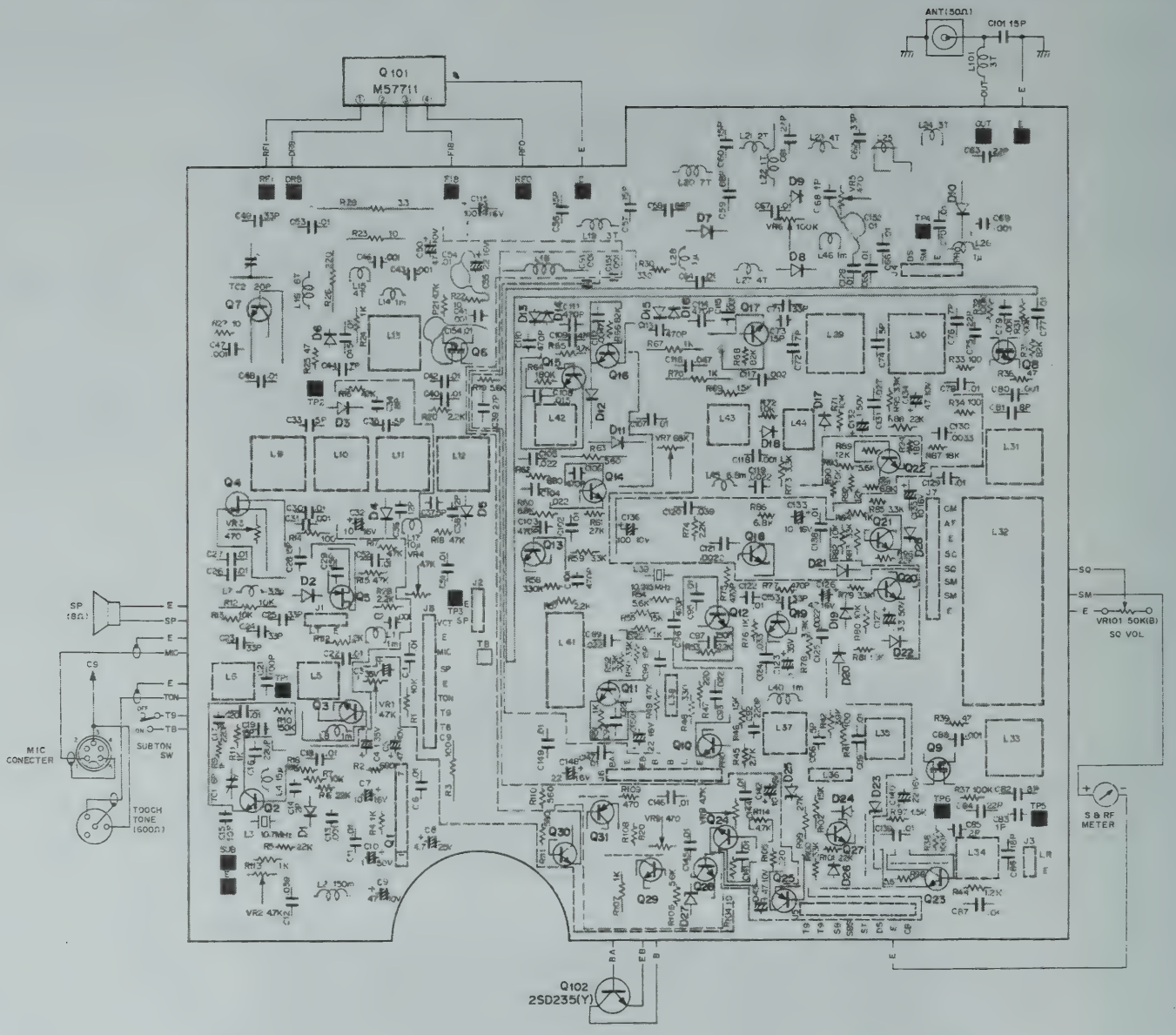


VIEWED FROM BOTTOM



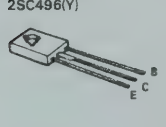
PC BOARD

■ TX-RX UNIT (X44-1300-10)

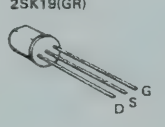


Q1	:TA7061AP	Q18,~22,26,29,30		D1~5,	:IS2208		D23 :XZ-088
Q2,3,10~17			:2SC1815(Y)	D6,13~16,21, 24,26,28	:IS1555		D25 :WZ-100
	:2SC460(B)	Q23,24	:2SC496(Y)	D7	:MI402		D27 :WZ-061
Q4,5	:2SK19(GR)	Q25	:2SA1015(Y)	D8	:IS2588		
Q6,8,9	:3SK74(L)	Q27	:2SC1959(Y)	D9~12,17,18,19,20		:IN60	
Q7	:2SC2053	Q31	:2SA496(Y)	D22	:IS1212		

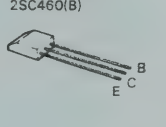
2SA496(Y)
2SC496(Y)



2SK19(GR)

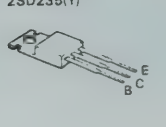


2SC458(B)
2SC460(B)

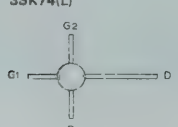


2SA1015(Y)
2SC1815(Y)
2SC1959(Y)

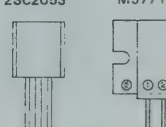
2SD235(Y)



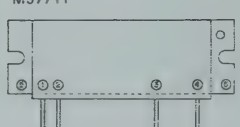
3SK74(L)



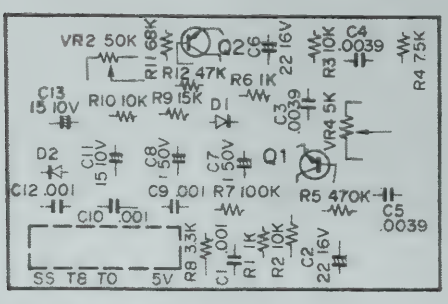
2SC2053



M57711



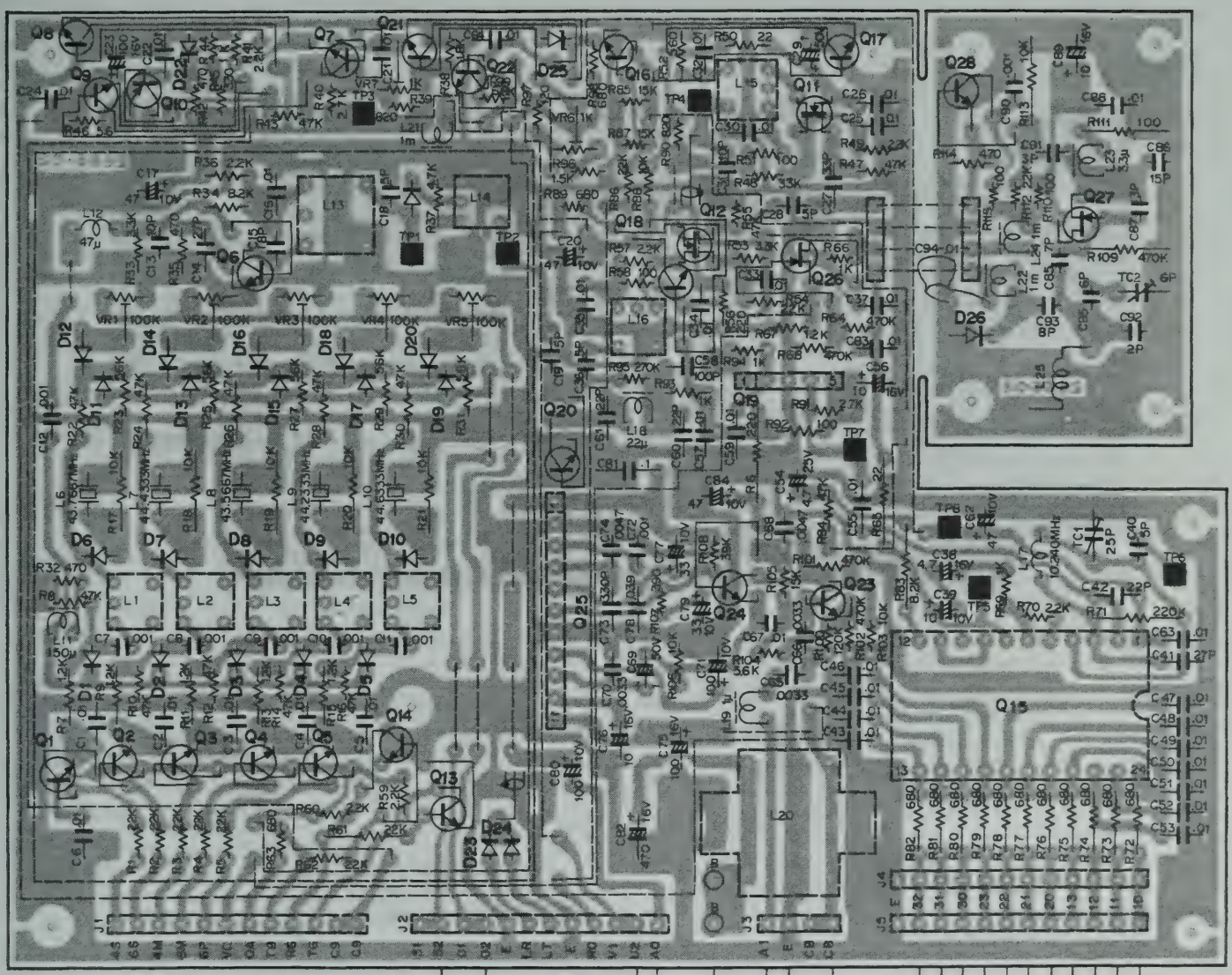
TONE UNIT (X52-1110-51) T TYPE

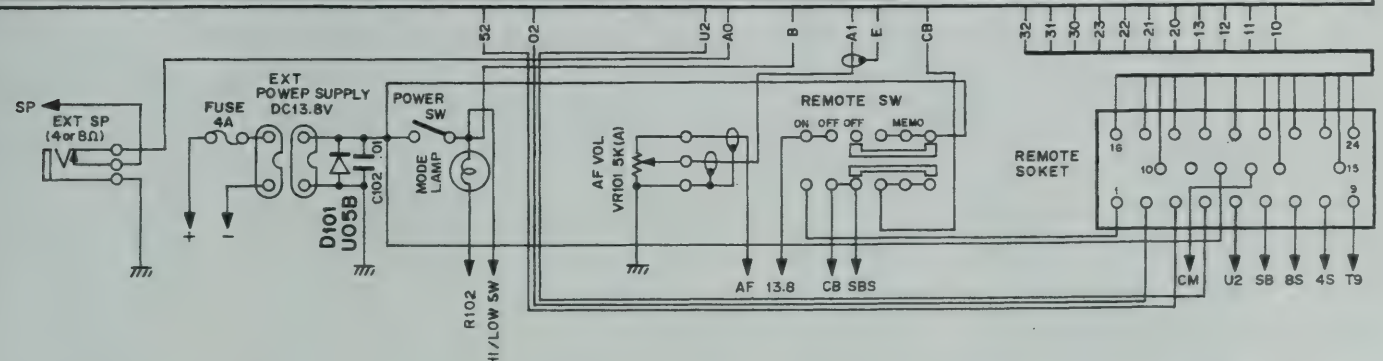


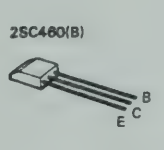
Q1,2 : 2SC458 (B)

PC BOARD

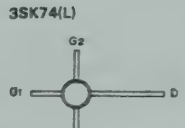
■ PLL UNIT (X50-1580-10)

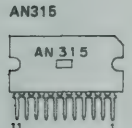


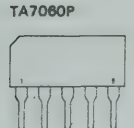


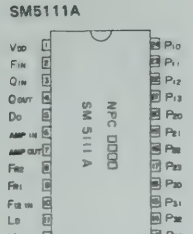


2SA1015(Y)
2SC1345(E)
2SC1815(Y)
2SC1923(O)
2SC1959(Y)
2SC2240(GR)







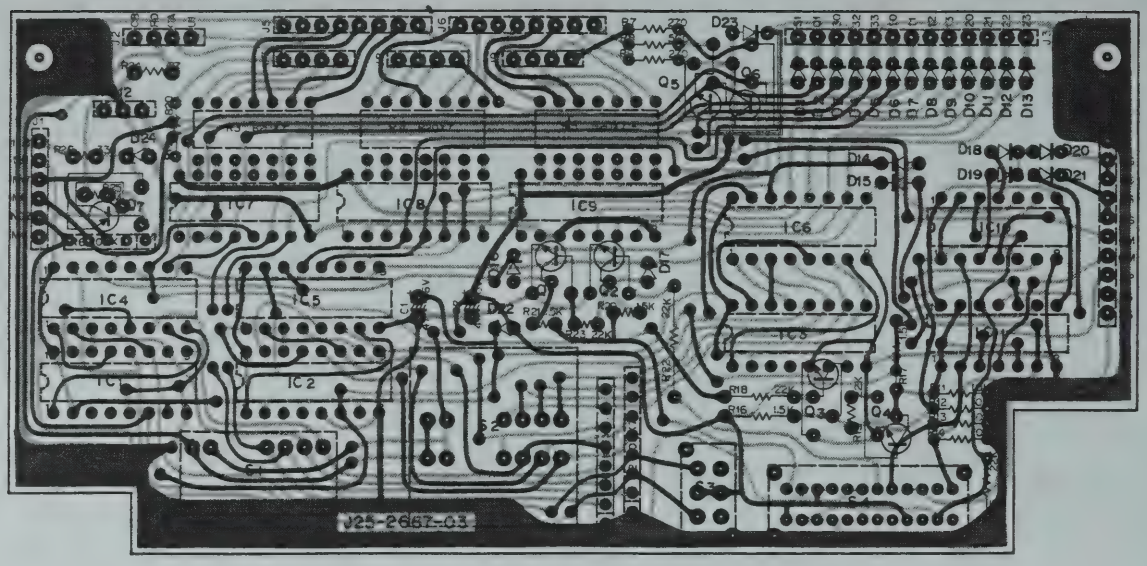


Q1~5,4,5,7,9,13,14,16,18,21,22	: 2SC1815 (Y)
Q6	: 2SC460 (B)
Q8	: 2SC1959 (Y)
Q10	: 2SA496 (Y)
Q11,12	: 3SK74 (L)
Q15	: SM5111A
Q17	: 2SC1345 (E)
Q19	: TA7060P
Q20,28	: 2SC1923 (O)
Q23,24	: 2SC2240 (GR)
Q25	: AN315
Q26	: 2SK30A (GR)
Q27	: 2SK19 (GR)
D1~5	: 1S2588
D6~10	: 1SV53A
D11~20	: 1S1555
D21	: 1S815
D22	: XZ-060
D23~24	: 1S2588
D25	: WZ-040
D26	: 1S2208

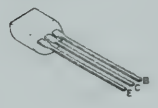
PC BOARD

■ CONTROL UNIT (X54-1380-00)

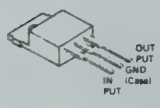
J25-2668-04



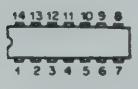
2SA1015(Y)
2SC1815(Y)



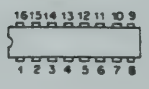
FS-7806M



TC4081P

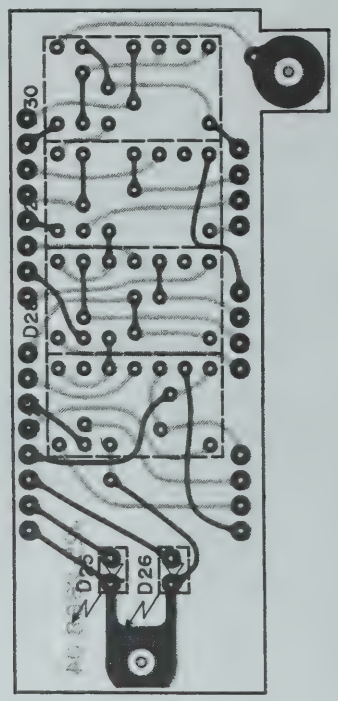


TC5022BP
TC4019BP
TC4035BP

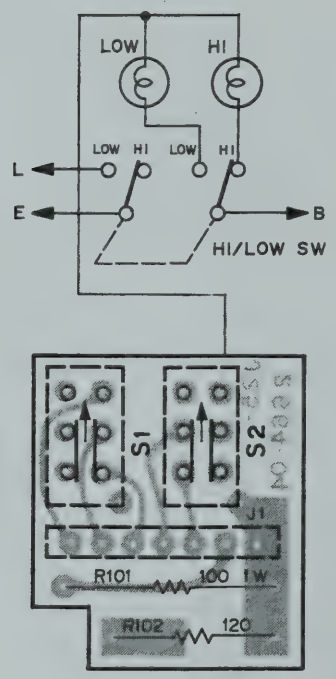


IC1~3	: TC4035BP	Q1~7	: 2SC1815(Y)
IC4~6	: TC4019BP	Q7	: 2SA1015(Y)
IC7~9	: TC5022BP	D1~13,15~22	: IN60
IC10, 11	: TC4081P-3/4	D23	: ISI555
IC10, 11	: TC4081P-1/4	D24	: WZ-150
IC12	: FS-7806M	D25	: TLG-205
		D26	: TLR-205
		D27~30	: 5130K

J25-2668-04 (Indicator)



J25-2664-04 (Switch)



PARTS LIST

NOTE:
Except special types (example: cement, metal film, etc.) resistors are not detailed in the PARTS LIST. Regarding value, refer to the schematic diagram or the PC board illustration. Resistors not otherwise detailed are carbon type (1/4 or 1/8W).
Order carbon resistors according to the following example:
A carbon resistor's part number is RD14BY 2E222J.

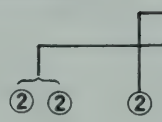
1. Type of the carbon resistor

RD14BY

RD14CY

2. Wattage
   1/4W → 2E
   1/8W → 2B

3. Resistance value



→ means $22 \times 10^2 = 2200\Omega$ (2.2kΩ)

Significant figure Multiplier
Example:
221 → 220Ω
222 → 2.2kΩ
223 → 22kΩ
224 → 220kΩ
225 → 2.2MΩ

GENERAL

☆ : New parts

Ref. No.	Parts No.	Description		Remarks
		CAPACITORS		
C101	CC45SL2H150D	Ceramic 15pF ±0.5pF		
C102	CK45F1J103Z	Ceramic 0.01μF +80,−20%		
C103	CK45B1H221K	Ceramic 220pF ±10%		
C104	CC45SL1H181J	Ceramic 180pF ±5%		
		SEMICONDUCTOR		
Q101	V30-1030-36	Power module M57711		☆
Q102	V04-0046-05	Transistor 2SD235 (Y)		
D101	V11-0270-05	Diode V05B		
		COIL		
L101	L34-0821-05	(No care) 5φ3T		☆
		POTENTIOMETER		
VR101	R19-9403-05	15kΩ (A) 50k (B)		
		MISCELLANEOUS		
—	A01-0734-13	Case (A)		☆
—	A01-0735-03	Case (B)		☆
—	A20-2334-05	Die casting panel (Front)	(K)	☆
—	A20-2339-03	Die casting panel (Front)	(W)	☆
—	A20-2340-03	Die casting panel (Front)	(T)	☆
—	B05-0707-04	Speaker grill cloth		☆
—	B10-0615-04	Front glass		☆
—	B31-0616-05	Meter		☆
—	B30-0802-05	Plot lamp (white)		
—	B30-0803-05	Pilot lamp (Blue)		
—	B30-0106-05	Pilot lamp (Small)		
—	B42-1602-04	Sticker	(K)	
—	B46-0058-00	Warranty card	(K)	
—	B50-2614-00	Operating manual	(K)	☆
—	B50-2628-00	Operating manual	(W)	☆
—	B50-2629-00	Operating manual	(T)	☆
—	E04-0152-05	M type receptacle		
—	E06-0453-05	4P metal socket (MIC)	(W) (T)	☆
—	E06-0552-05	5P metal socket (MIC)	(K)	☆
—	E07-0451-05	4P metal consent	(W) (T)	☆
—	E07-0551-05	5P metal consent	(K)	☆
—	E08-0203-25	2P connector (Jack)		

Ref. No.	Parts No.	Description		Remarks
—	E08-0471-05	4P socket (TONE PAD)	(K)	
—	E09-0471-05	4P plug (TONE PAD)	(K)	
—	E09-0203-25	2P connector (Plug)		
—	E11-0003-15	Earphone jack		
—	E12-0061-05	Phone plug		
—	E23-0043-04	Antenna earth lag		
—	E23-0015-04	Earth lag		
—	F01-0731-05	Heat sink		☆
—	F05-4022-05	Fuse (4A) × 2		
—	F20-0078-05	Isulating plate		
—	F29-0014-05	Insulating washer		
—	G02-0505-05	Fitting spring for knob		
—	G11-0054-14	Insulating cushion × 2		
—	G13-0616-04	Cushion (A) × 2		☆
—	G13-0617-04	Cushion (B)		☆
—	H01-2590-03	Carton case (Inside)	(K) (W)	☆
—	H01-2607-03	Carton case (Inside)	(T)	☆
—	H10-2519-02	Cushion		☆
—	H10-2501-03	Styren foam cushion		
—	H12-0447-04	Cushion		☆
—	H20-1408-03	Protection cover		☆
—	H25-0049-03	Bag with accessory		
—	H25-0079-04	Polytylene bag (MIC)		
—	H25-0103-04	Polyetylene bag (Cord)		
—	J13-0029-05	Fuse holder		
—	J21-2608-03	C type angle		☆
—	J51-0006-15	Snap-lock × 2		
—	J61-0019-05	Vinyl tie		
—	K21-0724-04	Knob (Outside)		☆
—	K21-0731-03	Knob (Mode)	(K)	☆
—	K21-0732-03	Knob channel (A)		☆
—	K21-0733-03	Knob channel (B)		☆
—	K21-0741-03	Knob mode	(W) (T)	☆
—	K23-0717-04	Knob		☆
—	K23-0719-04	Knob MHz		☆
—	K29-0712-04	Knob push (square) × 2		☆
—	K29-0713-04	Knob push (circle) × 3		☆
—	N99-0304-04	Hex. socket screws × 4		☆
—	S31-1402-05	Slide switch (remote)		
—	S36-2402-05	See saw switch (power)		

PARTS LIST

Ref. No.	Parts No.	Description	Remarks
—	S40-2409-05	Push switch (M)	☆
—	S40-2404-05	Push switch (MR)	
—	S40-2403-05	Push switch SUB, HI/LOW (W) HI/LOW	
—	T07-0201-05	Speaker (8Ω)	
—	T91-0310-05	Microphone (K)	☆
—	T91-0302-05	Microphone (W)	
—	T91-0301-05	Microphone (T)	
—	W01-0401-04	Wrench (Hex)	☆
—	X44-1300-10	TX-RX unit	
—	X50-1580-10	PLL unit (K)	☆
—	X50-1580-61	PLL unit (W) (T)	☆
—	X52-1110-62	TONE unit (W)	☆
—	X52-1110-51	TONE unit (T)	☆
—	X54-1440-10	CONTROL unit (K)	☆
—	X54-1440-61	CONTROL unit (W) (T)	☆

TX-RX Unit (X44-1300-10)

Ref. No.	Parts No.	Description	Remarks
		CAPACITOR	
C1	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C2	CK45B1H102K	Ceramic 0.001μF ±10%	
C3,4	CS15E1V0R1M	Tantalum 0.1μF 16WV	
C5	CE04W1A470	Electrolytic 47μF 10WV	
C6	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C7	CE04W1C100	Electrolytic 10μF 16WV	
C8	CE04W1E4R7	Electrolytic 4.7μF 25WV	
C9	CE04W1A470	Electrolytic 47μF 10WV	
C10	CE04W1H010	Electrolytic 1μF 50WV	
C11	CQ92M1H103K	Mylar 0.01μF ±10%	
C12	CQ92M1H393	Mylar 0.039μF ±10%	
C13	CK45B1H102K	Mylar 0.001μF ±10%	
C14	CC45UJ1H020C	Ceramic 2pF ±0.25pF	
C15	CC45TH1H100D	Ceramic 10pF ±0.5pF	
C16,17	CK45B1H221K	Ceramic 220pF ±10%	
C18	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C19	CC45CH1150J	Ceramic 15pF ±5%	
C20	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C21	CC45SL1H101J	Ceramic 100pF ±5%	
C22	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C23～25	CC45CH1H330J	Ceramic 33pF ±5%	
C26,27	CK46F1H103Z	Ceramic 0.01μF +80,−20%	
C28,29	CC45TH1H150J	Ceramic 15pF ±5%	
C30	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C31	CK45B1H102K	Ceramic 100pF ±10%	
C32	CE04W1C100	Electrolytic 110μF 16WV	
C33	CC45CH1H050C	Ceramic 5pF ±0.25pF	
C34	CC45TH1H080D	Ceramic 8pF ±0.5pF	
C35	CC45CH1H0R5C	Ceramic 0.5pF ±0.25pF	
C36	CC45TH1H120J	Ceramic 12pF ±5%	
C37	CC45CH1H0R5C	Ceramic 0.5pF ±0.25pF	
C38	CC45TH1H120J	Ceramic 12pF ±5%	
C39	CC45CH1H270J	Ceramic 27pF ±5%	
C40	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C41	CK45B1H102K	Ceramic 0.001μF ±10%	
C42	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C43	CK45B1H102K	Ceramic 0.001μF ±10%	
C44	CC45CH1H070D	Ceramic 7pF ±0.5pF	
C45	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C46,47	CK45B1H102K	Ceramic 0.001μF ±10%	
C48	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C49	CC45CH1H330J	Ceramic 33pF ±5%	
C50	CE04W1A470	Electrolytic 47μF 100WV	
C51～54	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C55	CE04W1C220	Electrolytic 22μF 16WV	
C56,57	CC45SL2H150J	Ceramic 15pF ±5%	
C58,59	CC45SL2H680J	Ceramic 68pF ±5%	
C60	CC45SL2H150J	Ceramic 15pF ±5%	
C61	CC45SL2H270J	Ceramic 27pF ±5%	
C62	CC45SL2H330J	Ceramic 33pF ±5%	
C63	CC45SL2H220J	Ceramic 22pF ±5%	
C64～67	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C68	CC45CH1H010C	Ceramic 1pF ±0.25pF	
C69	CK45B1H102K	Ceramic 0.001μF ±10%	
C70	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C71	CC45CH1H330J	Ceramic 33pF ±5%	
C72	CC45RH1H070D	Ceramic 7pF ±0.5pF	
C73	CC45LH1H150J	Ceramic 15pF ±5%	
C74	CC45CH1H050C	Ceramic 5pF ±0.25pF	
C75	CC45CH1H220J	Ceramic 22pF ±5%	
C76	CC45RH1H070D	Ceramic 7pF ±0.5pF	
C77,78	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C79,80	CK45B1H102K	Ceramic 0.001μF ±10%	
C81,82	CM93F2A080D	Mica 8pF ±0.5pF	
C83	CC45SL1H010C	Ceramic 1pF ±0.25pF	
C84	CC45CH1H220J	Ceramic 22pF ±5%	
C85	CC45CH1H020C	Ceramic 2pF ±0.25pF	
C86	CC45CH1H180J	Ceramic 18pF ±5%	
C87	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C88	CK45B1H102K	Ceramic 0.001μF ±10%	
C89	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C91	C91-0405-05	Trough type capacitor 0.001μF	
C92	CK45B1H221K	Ceramic 220pF ±10%	
C93,94	CQ92M1H223K	Mylar 0.022μF ±10%	
C95	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C96	CK45B1H471K	Ceramic 470pF ±10%	
C97	CC45SL1H151J	Ceramic 150pF ±5%	
C98	CC45CH1H150J	Ceramic 15pF ±5%	
C99	CQ92M1H223K	Mylar 0.022μF ±10%	
C101	CK45B1H471K	Ceramic 470pF ±10%	
C102	CQ92M1H103K	Mylar 0.01μF ±10%	
C103	CK45B1H471K	Ceramic 470pF ±10%	
C104,105	CQ92M1H223K	Mylar 0.022μF ±10%	
C106	CK45B1H471K	Ceramic 470pF ±10%	
C107	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C108	CQ92M1H153K	Mylar 0.015μF ±10%	
C109	CC45CH1H470J	Ceramic 47pF ±5%	
C110,111	CK45B1H471K	Ceramic 470pF ±10%	
C112	CQ92M1H472K	Mylar 0.0047μF ±10%	
C113,114	CK45B1H471K	Ceramic 470pF ±10%	
C115	CQ92M1H102K	Mylar 0.001μF ±10%	
C116	CQ92M1H473K	Mylar 0.047μF ±10%	
C117	CQ92M1H223K	Mylar 0.022μF ±10%	
C118	CQ92M1H102K	Mylar 0.001μF ±10%	
C119	CQ92M1H222K	Mylar 0.0022μF ±10%	
C120	CQ92M1H393K	Mylar 0.039μF ±10%	
C121	CQ92M1H222K	Mylar 0.0022μF ±10%	
C122	CQ92M1H103K	Mylar 0.01μF ±10%	
C123	CS15E1V0R1M	Tantalum 0.1μF 16WV	
C124	CQ92M1H333K	Mylar 0.033μF ±10%	
C125	CQ92M1H222K	Mylar 0.0022μF ±10%	
C126	CS15E1C4R7M	Tantalum 4.7μF 16WV	
C127	CE04W1H3R3	Electrolytic 3.3μF 50WV	
C128	CK45F1H103Z	Ceramic 0.01μF +80,−20%	

PARTS LIST

Ref. No.	Parts No.	Description	Re-marks
C129	CQ92M1H103K	Mylar 0.01μF ±10%	
C130	CQ92M1H332K	Mylar 0.0033μF ±10%	
C131	CQ92M1H273K	Mylar 0.027μF ±10%	
C132	CE04W1H010	Electrolytic 1μF 50WV	
C133	CE04W1C100	Electrolytic 10μF 16WV	
C134	CE04W1A470	Electrolytic 47μF 10WV	
C135	CE04W1C100	Electrolytic 10μF 16WV	
C136	CE04W1A101	Electrolytic 100μF 10WV	
C138,139	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C140	CE04W1C220	Electrolytic 22μF 16WV	
C141	CK451H103Z	Ceramic 0.01μF +80,−20%	
C142	CE04W1C100	Electrolytic 10μF 16WV	
C143	CE04W1A470	Electrolytic 47μF 10WV	
C144～147	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C148	CE04W1C220	Electrolytic 22μF 16WV	
C149	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C150	CE04W1C220	Electrolytic 22μF 16WV	
C151	C91-0405-05	Trough type capacitor 0.001μF	
C152	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C153	CC45SL1H330J	Ceramic 33pF ±5%	
C154	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C155	CE04W1C101Q	Electrolytic 100μF 16WV	
C156	CC45CH1H050C	Ceramic 5pF ±0.25pF	
C157～159	CC45TH1H020C	Ceramic 2pF ±0.25pF	
RESISTOR			
R29	RS14GB3D3R3J	Resistor (Metal Film) 3.3Ω	
SEMICONDUCTOR			
Q1	V03-0039-05	IC TA7061AP	
Q2,3	V03-0079-05	Transistor 2SC460 (B)	
Q4,5	V09-0012-05	FET 2SK19 (GR)	
Q6	V09-1002-56	FET 3SK74 (L)	
Q7	V03-2053-06	Transistor 2SC2053	☆
C8,9	V09-1002-56	FET 33K74 (L)	
Q10～17	V03-0079-05	Transistor 2SC460 (B)	
Q18～22	V03-1815-06	Transistor 2SC1815 (Y)	
Q23,24	V03-0336-05	Transistor 2SC496 (Y)	
Q25	V01-1015-06	Transistor 2SA1015 (Y)	
Q27	V03-1959-06	Transistor 2SC1959 (Y)	☆
Q28～30	V03-1815-06	Transistor 2SC1815 (Y)	
Q31	V01-0113-05	Transistor 2SA496 (Y)	
D1～5	V11-0317-05	Diode 1S2208	
D6	V11-0076-05	Diode 1S1555	
D7	V11-5260-16	Diode MI402	
D8	V11-0414-05	Diode 1S2588	
D9～12	V11-0051-05	Diode 1N60	
D13～16	V11-0076-05	Diode 1S1555	
D17～20	V11-0051-05	Diode 1N60	
D21	V11-0076-05	Diode 1S1555	
D22	V11-1262-06	Varistor 1S1212	
D23	V11-4163-56	Zener diode XZ-088	
D24	V11-0076-05	Diode 1S555	
D25	V11-0247-05	Zener diode WZ-100	
D26	V11-0076-05	Diode 1S1555	
D27	V11-0243-05	Zener diode WZ-061	
D28	V11-0076-05	Diode 1S1555	
POTENTIOMETER			
VR1,2	R12-1404-05	Potentiometer P6-S3NA 4.7kΩ	
VR3	R12-0406-05	Potentiometer P6-S3NA 470Ω	

Ref. No	Parts No.	Description	Re-marks
VR4	R12-1404-05	Potentiometer P6-S3NA 4.7kΩ	
VR5	R12-0406-05	Potentiometer P6-S3NA 470Ω	
VR6	R12-5403-05	Potentiometer P6-S3NA 100kΩ	
VR7	R12-4404-05	Potentiometer P6-S3NA 68kΩ	
VR8	R12-1404-05	Potentiometer P6-S3NA 4.7kΩ	
VR9	R12-0406-05	Potentiometer P6-S3NA 470Ω	
TRIMMER			
TC1	C05-0062-05	Ceramic trimmer 6pF ECV1ZW6P	
TC2	C05-0013-15	Ceramic trimmer 20pF ECV1ZW20P	
COIL/INDUCTOR/CRYSTALQUARTZ			
L1	L40-1021-03	Ferri inductor 1mH	
L2	L40-1545-06	Ferri inductor 150mH	
L3	L77-0710-05	Crystal quartz (10.7 MHz)	
L4	L33-0615-05	Choke coil 15μH	
L5	L30-0005-05	IFT	
L6	L31-0313-05	IFT	
L7	L40-3391-03	Ferri inductor 3.3μH	
L8	L40-1021-03	Ferri inductor 1 mH	
L9	L31-0344-05	Tuning coil	
L10	L31-0180-05	Tuning coil	
L11,12	L31-0267-05	Tuning coil	
L13	L34-0672-05	Tuning coil	
L14	L40-1021-03	Ferri inductor 1 mH	
L15	L34-0814-05	VHF coil 4φ4T	☆
L16	L34-0452-05	VHF coil 3φ6T	
L17	L40-1001-03	Ferri inductor 10μH	
L18	L33-0074-05	Choke coil 0.3μH	
L19	L34-0813-05	VHF coil 4φ3T	☆
L20	L34-0819-05	VHF coil 5φ7T	☆
L21	L34-0816-05	VHF coil 5φ2T	☆
L22	L34-0815-05	VHF coil 5φ1T	☆
L23	L34-0814-05	VHF coil 4φ4T	☆
L24	L34-0817-05	VHF coil 5φ3T	☆
L25	L39-0052-05	Inspecting coil	
L26	L33-0002-05	Choke coil 1μH	
L27	L34-0818-05	VHF coil 5φ4T	☆
L28	L33-0025-05	Choke coil 1μH	
L29,30	L34-0694-05	Tuning coil	
L31	L34-0812-012	Tuning coil	☆
L32	L79-0451-05	Helical block	☆
L33	L34-0812-05	Tuning coil	☆
L34	L34-0683-05	Tuning coil	☆
L35	L30-0289-05	IFT	
L36	L71-0201-05	Monolitic filter 10F15A	
L37	L30-0289-05	IFT	
L38	L72-0014-05	Ceramic filter SFE-10.7 MA5	
L39	L77-0327-05	Crystal quartz (10.245 MHz)	
L40	L40-1021-03	Ferri inductor 1 mH	
L41	L72-0309-05	Ceramic filter CFT-455FZ	
L42	L30-0504-05	IFT	
L43	L30-0503-05	IFT	
L44	L79-0442-05	Ceramic discri 455-D	
L45	L40-6825-04	Ferri inductor 6.8 mH	
L46	L40-1021-03	Ferri inductor 1 mH	
MISCELLANEOUS			
	E23-0046-04	Terminal (square) × 16	
	E23-0401-05	Terminal (circle)	

PARTS LIST

PLL Unit (X50-1580-10)

Ref. No.	Parts No.	Description	Remarks
		CAPACITOR	
C1～6	CK451H103Z	Ceramic 0.01μF +80,−20%	
C7～12	CJ45B1H102K	Ceramic 0.001μF ±10%	
C13	CC45CH1H100D	Ceramic 10pF ±0.5pF	
C14	CC45CH1H270J	Ceramic 27pF ±0.5%	
C15	CC45UJ1H180J	Ceramic 18pF ±5%	
C16	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C17	CE04W1A470	Electrolytic 47μF 10WV	
C18,19	CC45LH1H050C	Ceramic 5pF ±0.25pF	
C20	CE04W1A470	Electrolytic 47μF 10WV	
C21,22	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C23	CE04W1C101Q	Electrolytic 100μF 16WV	
C24～26	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C27	CC45CH1H330J	Ceramic 33pF ±5%	
C28	CC45CH1H050C	Ceramic 5pF ±0.25pF	
C29	CE04W1H010	Electrolytic 1μF 50WV	
C30	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C31	CC45CH1H100D	Ceramic 10pF ±0.5pF	
C32～35	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C36	CC45CH1H050C	Ceramic 5pF ±0.25pF	
C37	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C38	CS15E1C4R7M	Tantalum 4.7μF 16WV	
C39	CS15E1A100M	Tantalum 10μF 10WV	
C40	CC45CH1H050C	Ceramic 5pF ±0.25pF	
C41	CC45CH1H270J	Ceramic 27pF ±0.5%	
C42	CC45CH1H220J	Ceramic 22pF ±5%	
C43～53	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C54	CE04W1E4R7	Electrolytic 4.7μF 25WV	
C55	C90-0246-05	Ceramic 0.01μF ±10%	
C56	CE04W1C100	Electrolytic 10μF 16WV	
C57	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C58	CC45SL1H101J	Ceramic 100pF ±5%	
C59	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C60,61	CC46CH1H220J	Ceramic 22pF ±5%	
C62	CE04W1A470	Electrolytic 47μF 10WV	
C63,64	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C65,66	CQ92M1H332K	Mylar 0.0033μF ±10%	
C67	CQ92M1H103K	Mylar 0.01μF ±10%	
C68	CQ92M1H472K	Mylar 0.0047μF ±10%	
C69	CE04W1H010	Electrolytic 1μF 50WV	
C70	CQ92M1H332K	Mylar 0.0033μF ±10%	
C71	CE04W1A101Q	Electrolytic 100μF 10WV	
C72	CQ92M1H102K	Mylar 0.001μF ±10%	
C73	CK453B1H331K	Ceramic 330pF ±10%	
C74	CQ92M1H472K	Mylar 0.0047μF ±10%	
C75	CE04W1C101Q	Electrolytic 100μF 16WV	
C76	CE04W1C100	Electrolytic 10μF 16WV	
C77	CE04W1A330	Electrolytic 33μF 10WV	
C78	CQ92M1H303K	Mylar 0.039μF ±10%	
C79	CE04W1A330	Electrolytic 33μF 10WV	
C80	CE04W1A101Q	Electrolytic 100μF 10WV	
C81	CQ92M1H104K	Mylar 0.1μF ±10%	
C82	CE04W1C471Q	Electrolytic 470μF 16WV	
C84	CE04W1A470	Electrolytic 47μF 10WV	
C85	CC45CH1H070D	Ceramic 7pF ±0.5pF	
C86	CC45CH1H150J	Ceramic 15pF ±5%	
C87	CC45CH1H030C	Ceramic 3pF ±0.25pF	
C88	CK45F1H103Z	Ceramic 0.01μF +80,−20%	
C89	CE04W1C100	Electrolytic 10μF 16WV	
C90	CK45B1H102K	Ceramic 0.001μF ±10%	
C91	CC45CH1H030C	Ceramic 3pF ±0.25pF	
C92	CC45UJ2H020C	Ceramic 1pF ±0.25pF	
C93	CC45CH1H080D	Ceramic 8pF ±0.5pF	
C94	CQ92M1H103K	Mylar 0.01μF ±10%	
C95	CC45UJ1H060D	Ceramic 6pF ±0.5pF	
		SEMICONDUCTOR	
Q1～5	V03-1815-06	Transistor 2SC1815 (Y)	
Q6	V03-0079-05	Transistor 2SC460 (B)	
Q7,8	V03-1815-06	Transistor 2SC1815 (Y)	
Q9	V03-1959-06	Transistor 2SC1959 (Y)	
Q10	V01-0113-05	Transistor 2SA496 (Y)	
Q11,12	V09-1002-56	FET 3SK74 (L)	
Q13,14	V03-1815-06	Transistor 2SC1815 (Y)	
Q15	V30-1030-46	IC SM5111A	☆
Q16	V03-1815-06	Transistor 2SC1815 (Y)	
Q17	V03-0272-05	Transistor 2SC1345 (E)	
Q18	V03-1815-06	Transistor 2SC1815 (Y)	
Q19	V30-0087-05	IC TA7060P	
Q20	V03-1923-06	Transistor 2SC1923 (O)	☆
Q21,22	V03-1815-06	Transistor 2SC1815 (Y)	
Q23,24	V03-2240-06	Transistor 2SC2240 (GR)	
Q25	V30-0208-05	IC AN315	
Q26	V09-0060-05	FET 2SK30A (GR)	
Q27	V09-1001-16	FET 2SK19 (GR) (T)	
Q28	V03-1923-06	Transistor 2SC1972 (O)	☆
D1～5	V11-0414-05	Diode 1S2588	
D6～10	V11-4161-36	Diode 1SV53A	
D11～20	V11-0076-05	Diode 1S1555	
D21	V11-0374-05	Diode 1SS16	
D22	V11-4161-16	Zener diode XZ-061	
D23,24	V11-0414-05	Diode 1S2588	
D25	V11-4161-56	Zener diode WZ-040	☆
D26	V11-0317-05	Diode 1S2208	
		POTENTIOMETER	
VR1～5	R12-5403-05	Potentiometer 100kΩ	
VR6,7	R12-1403-05	Potentiometer 1kΩ	
		TRIMMER	
TC1	C05-0067-05	Ceramic trimmer 5P	
TC2	C05-0062-05	Ceramic trimmer 6P	
		COIL/INDUCTOR	
L1～5	L34-0437-05	Choke coil	☆
L6	L77-0832-05	Crystal quartz 43.7667 MHz	☆
L7	L77-0833-05	Crystal Quartz 44.4333 MHz	☆
L8	L77-0834-05	Crystal Quartz 43.5667 MHz	☆
L9	L77-0835-05	Crystal Quartz 44.2333 MHz	☆
L10	L77-0836-05	Crystal Quartz 44.6333 MHz	☆
L11	L40-1511-03	Ferri-inductor 150μH	
L12	L33-0605-05	Choke coil 0.47μH	
L13	L32-0002-05	Oscillator coil	
L14	L34-0683-05	Tuning coil	
L15	L34-0820-05	Tuning coil	☆
L16	L34-0683-05	Tuning coil	
L17	L77-0720-05	Crystal Quartz 10.240 MHz	
L18	L40-2201-03	Ferri-inductor 22μH	
L19	L40-1091-03	Ferri-inductor 1μH	
L20	L15-0016-05	Choke coil (Low frequency)	
L21,22	L40-1021-03	Ferri-inductor 1mH	
L23	L40-3391-03	Ferri-inductor 3.3μH	
L25	L32-0618-05	Oscillator coil	☆
		MISCELLANEOUS	
	E23-0046-04	Terminal × 8 (square)	
	E23-0401-05	Terminal × 2 (circle)	

PARTS LIST/PACKING

CONTROL UNIT (X54-1440-10)

Ref. No.	Parts No.	Description	Re-marks
		CAPACITOR	
C1	CE04W1C470Q	Electrolytic 47μF 16WV	
C2	CE04W1A470	Electrolytic 47μF 10WV	
R1,2	R90-0514-05	Resistor block 10k×7	
R3～5	R90-0516-05	Resistor network	
R6	R90-0515-05	Resistor block 10k×4	
Q1～6	V03-1815-06	Transistor 2SC1815 (Y)	
Q7	V01-1015-06	Transistor 2SC1015 (Y)	
IC1～3	V30-1006-46	IC TC4035BP	☆
IC4～6	V30-0232-26	IC TC4019BP	
IC7～9	V30-0232-76	IC TC5022BP	
IC10,11	V30-1006-36	IC TC4081BP	☆
IC12	V30-1025-26	IC FS7806M	☆
D1～22	V11-0051-05	Diode 1N60	
D23	V11-0076-05	Diode 1S1555	
D24	V11-0307-05	Zenner diode WZ-150	
D25	V11-3162-86	LED TLG205	☆
D26	V11-3162-96	LED TLR205	☆
D27～30	V11-4161-66	LED 513 OK	☆
S1	S29-1406-05	Rotary switch (1 MHz) K	☆
S4	S29-1408-05	Rotary switch (1 MHz) W	☆
S2	S29-1405-05	Rotary switch (1000 kHz, 10 kHz)	☆
S3	S40-2405-05	Push switch (0k, 5k)	
S4	S29-4402-05	Slide rotary (for shift)	☆

TONE UNIT (X52-1110-50) (T TYPE) (X52-1110-61) (W TYPE)

Ref. No.	Parts No.	Description	Re-marks
C1	CD45B1H102K	Ceramic 1000pF ±10%	
C2	CE04W1C220Q	Electrolytic 22μF 16WV	
C3～5	C91-0433-05	Layer-built 0.0039μF ±5%	☆
C6	CE04W1C220Q	Electrolytic 22μF 16WV	
C7,8	CE04W1H010	Electrolytic 1μF 50WV	
C9,10	CK45B1H102K	Ceramic 1000pF ±10%	
C11	CS15E1A150K	Tantalum 15μF ±10%	(T)
C12	CK45B1H102K	Ceramic 1000pF ±10%	
C13	CS15E1A150K	Tantalum 15μF ±10%	(T)
		RESISTOR	
R1～12	RD14CB2EOOOJ But	Carbon OOOΩ ±5% 1/W	
R2,3	R92-0616-05	Metal film 10kΩ ±1% 1/W	☆
R4	R92-0617-05	Metal film 7.5kΩ ±1% 1/W	☆
R5	RN14BK2E4703F	Metal film 470kΩ ±1% 1/W	
R10	RD14CB2E102J	Carbon 15kΩ ±5% 1/W	(T)
		SEMICONDUCTOR	
Q1,2		Transistor 2SC458 (B)	
D1,2		Diode 1S1555	(T)
D1		Diode 1S1555	(W)
		POTENTIOMETER	
VR1	R12-2405-05	Semi-fixed resistor 5kΩ	☆
VR2	R12-4403-05	Semi-fixed resistor 50kΩ	(T)☆
		MISCELLANEOUS	
—	E40-0464-05	Pin plug	

PACKING

ACCESSORIES SUPPLIED

1. Dynamic microphone equipped with
   5-pin plug (T91-0310-05) (K)..... 1 piece
   4-pin plug (T91-0301-05) (T)
   4-pin plug (T91-0302-05) (W)
2. Mounting bracket (J21-2608-03)..... 1 piece
3. Mounting parts
   Hex. socket screws (N99-0304-04)..... 4 pieces
   Screws, 6 mm diameter (N09-0008-04)..... 4 pieces
   Plain washers, 6 mm diametr
   (N15-1060-46)..... 4 pieces
   Spring washers, 6 mm diameter
   (N16-0060-41)..... 4 pieces
   Nuts, 6 mm diameter (N14-0009-04)..... 4 pieces
4. Snap-lock (J51-0006-15)..... 2 pieces
5. Label..... 1 sheet
6. Spare fuse, 4A (F05-1031-05)..... 1 piece
7. DC power cord with plug and fuse..... 1 piece
8. Miniature plug for external speaker
   (E12-0001-05) and touch tone pad
   (E08-0471-05)..... 2 pieces
   (E09-0471-05)
9. Operating manual (B50-2614-00) (K)..... 1 copy
   (B50-2628-00) (W)
   (B50-2629-00) (T)

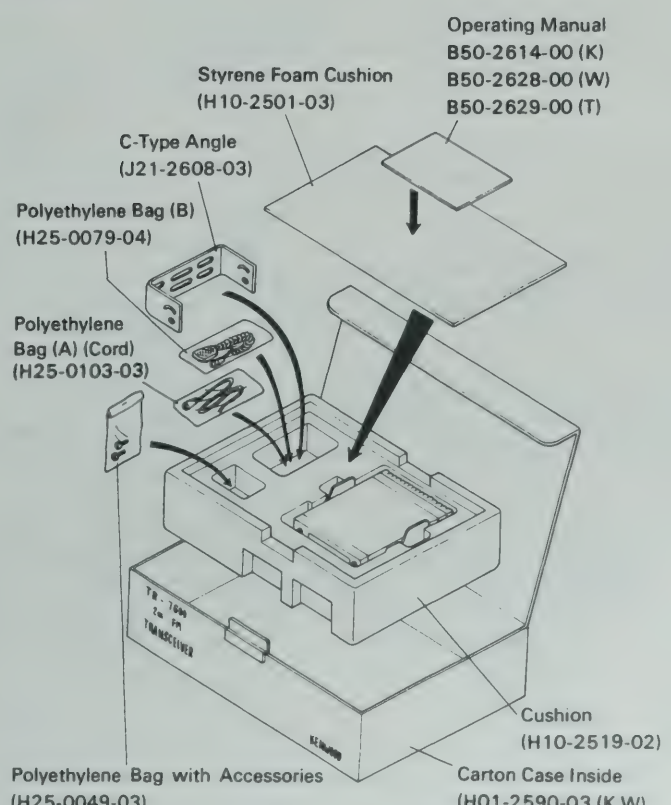


Fig. 9 Packing

EXPLODED VIEW

I. Removing the case
(1) Remove the bind screws ① ~ ⑪.
(2) Remove the upper and 2 lower cases.

II. Removing the panel
(1) Remove the knobs.
(2) Remove the screws Ⓐ ~ Ⓓ

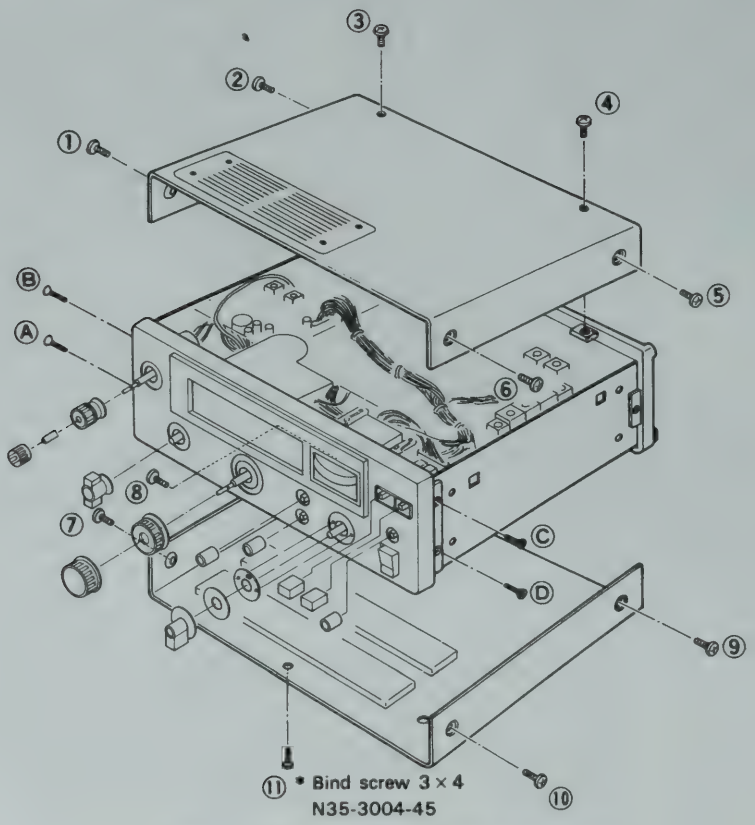


Fig. 10 Removing the Panel and Case

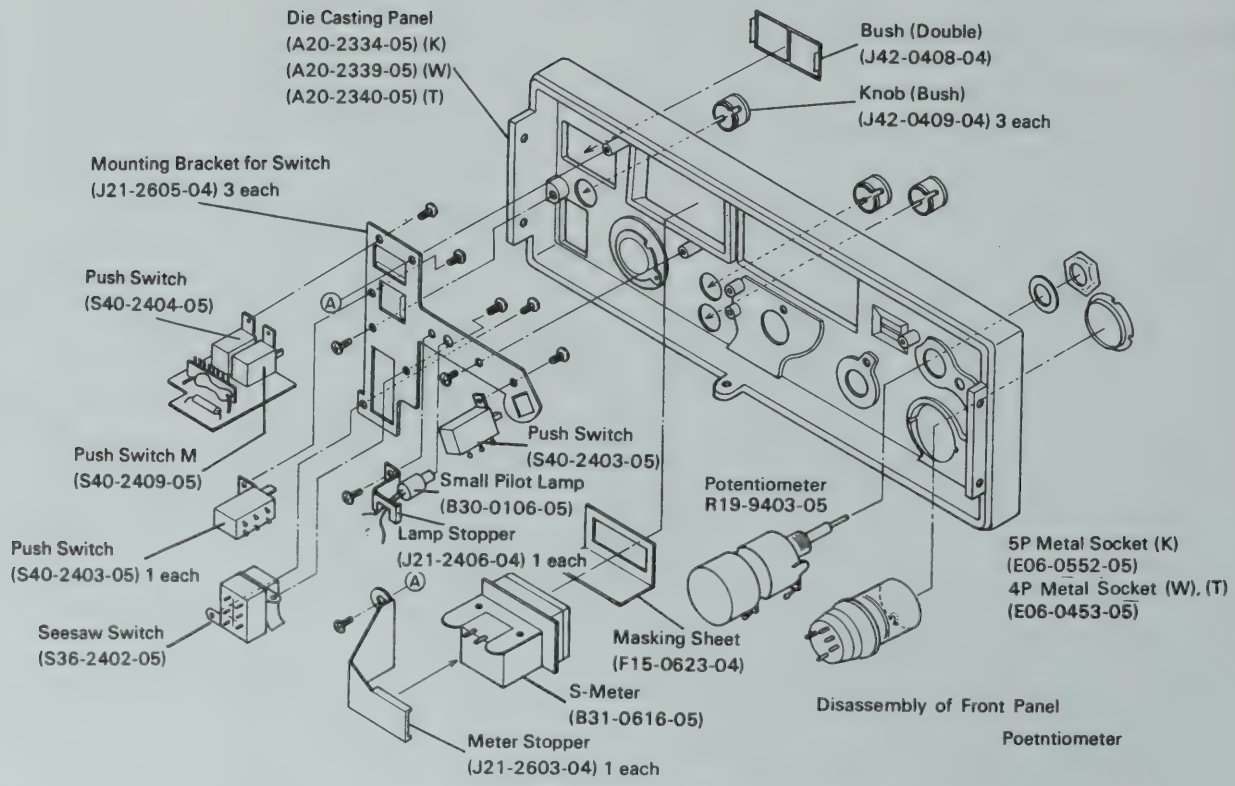
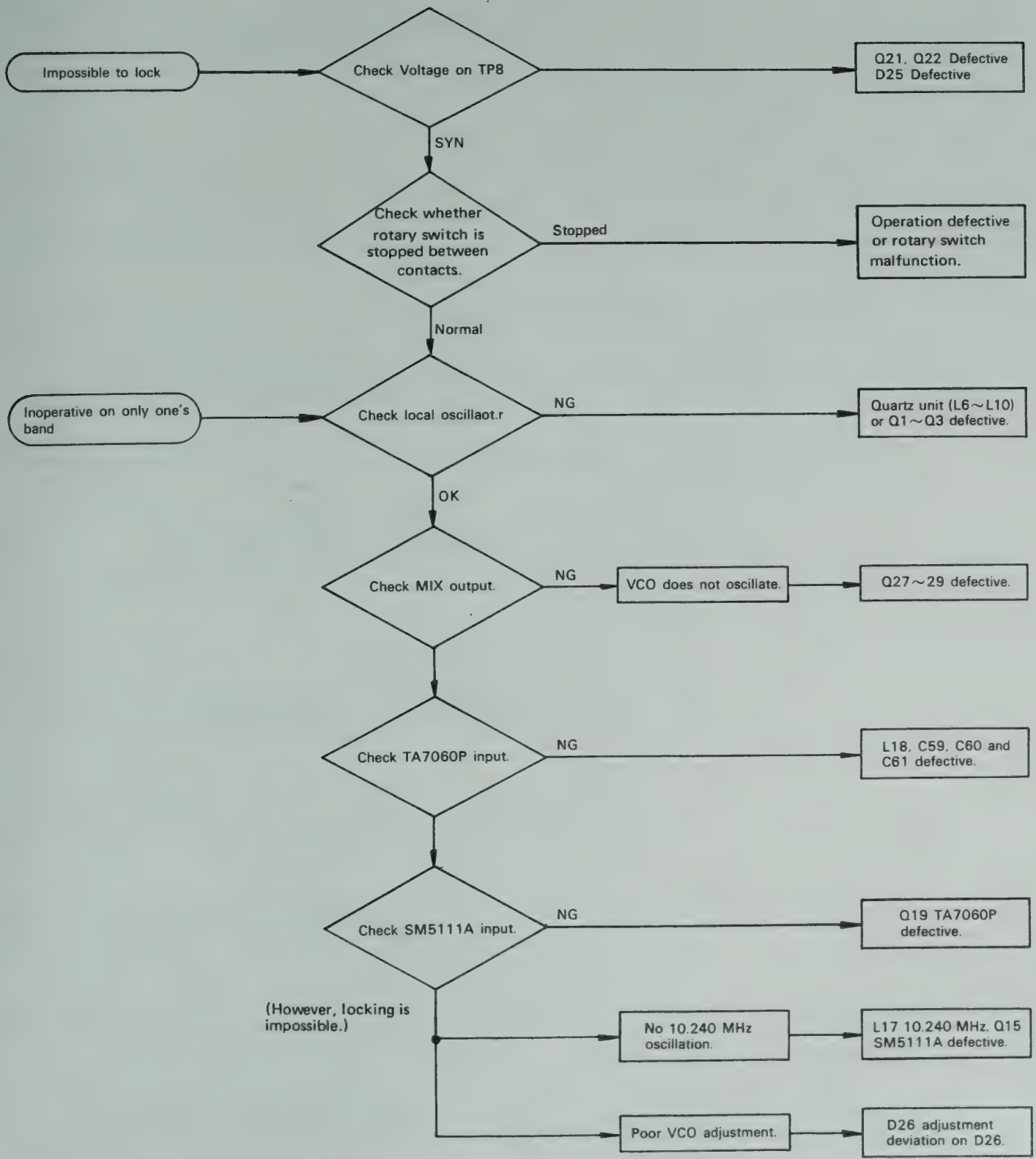


Fig. 11 Disassembly of Front Panel

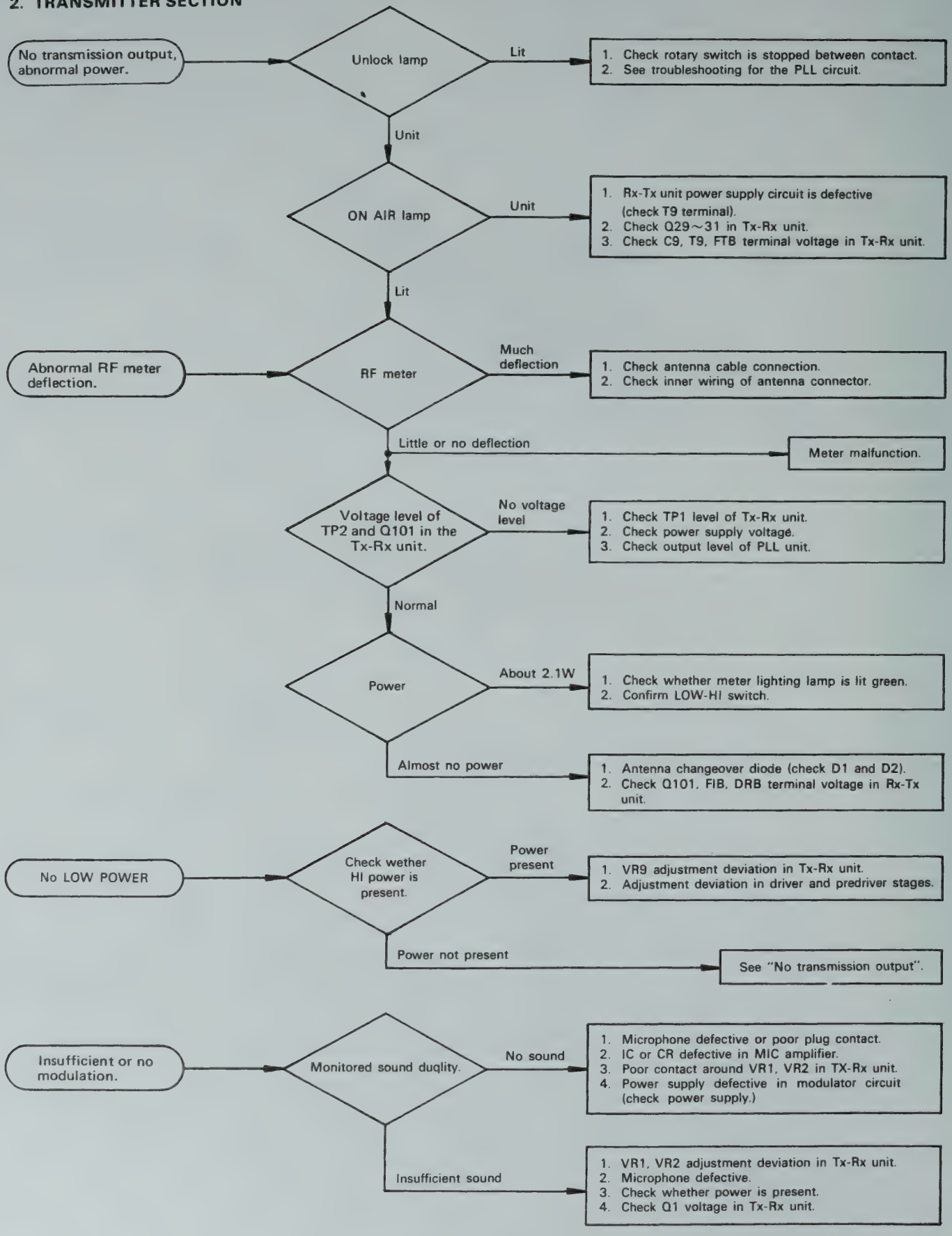
TROUBLESHOOTING

1. PLL CIRCUIT



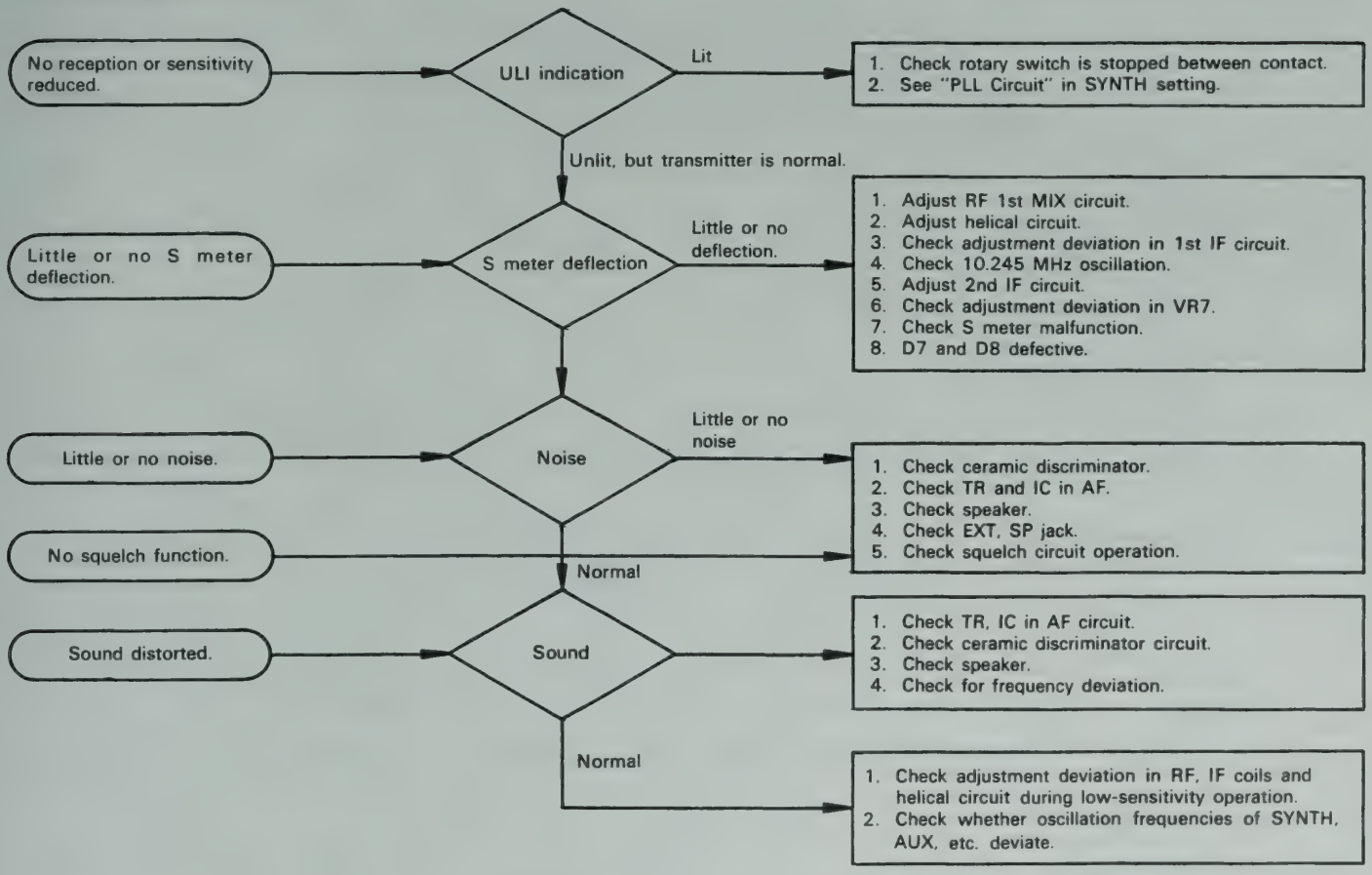
TROUBLESHOOTING

2. TRANSMITTER SECTION



TROUBLESHOOTING/ADJUSTING

3. RECEIVER SECTION



ADJUSTMENT

TEST EQUIPMENT REQUIRED

1. DC Power Supply
Voltage: Variable from 9 to 16 V.
Current: 4 A min.

2. DC Voltmeter
Voltage range: 10 V~16 V (min.)
Input inpedance: Sufficient (1MΩ/VDC)

3. RF Valve Voltmeter
Voltage range: F.S. 10 mV~300 V
Measuring frequency: 200 MHz min.
Input impedance: 1 MΩ min., 3 pF max.

4. Frequency Counter
Measuring frequency: 150 MHz min.
Min. input sensitivity: about 50 mV

5. Oscilloscope:
With horizontal input terminal and high sensitivity,
Measuring frequency: 3 MHz min.

6. Power Meter
Measuring frequency: 150 MHz min.
Impedance: 50Ω
Measuring range: 20W, 3W

7. Linear Detector

8. AG
Frequency range: 300 Hz~5 kHz
Output: 0.5 mV~1 V

9. AF Valve Voltmeter
Measuring frequency: 50 Hz 10 kHz
Input impedance: 1 MΩ min.
Voltage range: F.S. 3 mV~30 V

10. SSG
Output frequency: Capable of covering 144 MHz ~148 MHz
Modulation: Frequency modulation is possible.

11. Sweep Generator
Frequency range: Capable of covering 144 MHz ~148 MHz

12. Dummy
8Ω 5W (approx.)

13. Directional Coupler

14. Detector

ADJUSTMENT

1. Adjustment of PLL circuit

Item	Condition	Measuring point			Adjusting point			Reference	Remarks
		(Measure instruments)	Unit	Terminal	Unit	Parts	Method		
1. Voltage check and adjustment	1) POWER SW: ON HI/LOW SW: HI MR SW: OFF MODE SW: S MHz SW: 6 100 kHz SW: 0 10 kHz SW: 0 SUBTONE SW: O 5Hz SW: 0 REMOTE SW: OFF SEND/REC. SW: SEND	DC V.M	PLL	T9 (J1)				8.9V～10.2V	Confirm
			TX.RX	T9				8.9V～10.2V	Confirm
				EB				Approx. 12V	Confirm
	2) SEND/REC. SW: REC.	DC V.M	TX.RX	R9				7.7V～8.3V	Confirm
	3) Same as above.	DC V.M	PLL	TP3	PLL	VR7	8.0V	±0.2V	
	4) Same as item 2)	DC V.M	PLL	TP8	PLL	VR6	6.0V	±0.2V	
2 PLL	1) 100 kHz SW: 0 10 kHz SW: 0	RF V.M	PLL	TP1	PLL	L13	Turn the L13 core counter clockwise (180°) from the oscillation start point.	0.46V	
				TP7		L14 L16	MAX	1.4V	
	2) MHz SW: 4	DC V.M	PLL	TP5	PLL	TC2	1.5V	±0.05V	
	3) MHz SW: 7 100 kHz SW: 9 10 kHz SW: 9	DC V.M	PLL	TP5				Less than 5.5V	Confirm
	4) Same as above	F.Count	PLL	TP6	PLL	TC1	10.24000 Hz	±100 Hz	
	5) MHz SW: 4 100 kHz SW: 0 10 kHz SW: 0 5 kHz SW: 5 kHz	Frequency Counter	PLL	TP4	PLL	L1	133.3050 MHz	±100 Hz	
	6) MHz SW: 6					L2	135.3050 MHz	±100 Hz	
	7) MHz SW: 5 MODE SW: ⊖					L3	133.7050 MHz	±100 Hz	
	8) MHz SW: 7					L4	135.7050 MHz	±100 Hz	
	9) MODE SW: ⊕					L5	136.9050 MHz	±100 Hz	
Calibration of counter at 10.24 MHz	When a frequency counter is connected to the TP6 of the PLL unit, the 10.24 MHz signal is devited because of the impedance, so the counter should be calibrated using the following procedure. MHz SW: 4 100 kHz SW: 0 10 kHz SW: 0 ↓ MHz SW: 5	Frequency Counter	PLL	TP4	PLL	TC1	With the MHz SW set to "4" and "5" check that the signal on the TP6 is 10.24 MHz at each position when the TC1 is adjusted so that the signal of 100 Hz order on the TP4 remains unchanged.		
	10) MHz SW: 4 5 kHz SW: 0 MODE SW: S SEND/REC. SW: REC.		PLL	TP4	PLL	VR1	133.3000 MHz	±100 Hz	
	11) MHz SW: 6					VR2	135.3000 MHz	±100 Hz	
	12) MHz SW: 5 MODE SW: ⊖ SEND/REC. SW: SEND					VR3	133.7000 MHz	±100 Hz	
	13) MHz SW: 7					VR4	135.7000 MHz	±100 Hz	
	14) MODE SW: ⊕ Recheck the frequencies in Item (5) through (9). If they are devited, readjust L1 through L5.					VR5	136.9000 MHz	±100 Hz	

ADJUSTMENT

Item	Condition	Measuring point			Adjusting point			Reference	Remarks
		(Measure instruments)	Unit	Terminal	Unit	Parts	Method		
	15) MHz SW: 5 100 kHz SW: 9 10 kHz SW: 9 MODE SW: S SEND/REC. SW: REC.		PLL	TP4				135.2900 MHz± 100 Hz	Confirm
	16) MHz SW: 7							137.2900 MHz ± 100 Hz	Confirm
	17) MHz SW: 5 MODE SW: ⊖ SEND/REC. SW: SEND							134.6900 MHz± 100 Hz	Confirm
	18) MHz SW: 7							136.6900 MHz± 100 Hz	Confirm
	19) MHz SW: 4 100 kHz SW: 0 10 kHz SW: 0							132.7000 MHz± 100 Hz	Confirm
	20) MHz SW: 6	Frequency Counter	PLL	TP4				134.7000 MHz± 100 Hz	Confirm
	21) MHz SW: 5 SEND/REC. SW: REC.							134.3000 MHz± 100 Hz	Confirm
	22) MHz SW: 7							136.3000 MHz± 100 Hz	Confirm
	23) MHz SW: 6 MODE SW: ⊕							135.9000 MHz± 100 Hz	Confirm
	24) MHz SW: 7 SEND/REC. SW: REC.							136.3000 MHz± 100 Hz	Confirm
	25) MHz SW: 4 SEND/REC. SW: SEND & REC.							133.3000 MHz± 100 Hz	Confirm
	26) MHz SW: 5 SEND/REC. SW: SEND & REC.							134.3000 MHz± 100 Hz	Confirm
	27) MHz SW: 4→5→6→7→4 MODE SW: S SEND/REC. SW: REC.		PLL	TP4				The frequency should become higher than 133.3000 MHz in 1 MHz steps and should return to the original frequency at the "4" position.	Confirm
	28) 100 kHz SW: 0→1→ ..... 9→0							The frequency should become higher than 133.3000 MHz in 100 kHz steps and should return to the original frequency at the "0" position.	Confirm
	29) 10 kHz SW: 0→1→ ..... 9→0							The frequency should become higher than 133.3000 MHz in 10 kHz steps and should return to the original frequency at the "0" position.	Confirm
	30) MHz SW: 6 SEND/REC. SW: SEND	RF V.M	PLL	TP4	PLL	L15	MAX		
3. Paint lock	1) L1. L2. L3. L4. L5. L13								

ADJUSTMENT

2. Adjustment of TX section

Item	Condition	Measuring point			Adjusting point			Reference	Remarks
		(Measure instruments)	Unit	Terminal	Unit	Parts	Method		
1. SET	1) POWER SW: ON HI/LOW SW: HI MR SW: OFF MODE SW: S MHz SW: 4 100 kHz SW: 0 10 kHz SW: 0 5 kHz SW: 0 SUBTONE SW: OFF REMOTE SW: OFF SEND/REC. SW: SEND TC 1: Centered TC 2: Centered VR8: Full counter clockwise (FCCW)								
2. 10.7 MHz	1) Ready for UNLOCK	RF. V.M	TX.RX	TP1	TX.RX	L5,L6	MAX	0.4 V	
	2) Same as above	F.Counter	TX.RX	TP1	TX.RX	TC1	10.7000 MHz	±100 Hz	
3. VCT	1) Ready for UNLOCK MHz SW: 4→5→6→7	DC V.M	TX.RX	TP3				Check voltage goes down step by step	Confirm
4. B.P.F DRIVE	1) MHz SW: 6	RF V.M	TX.RX	gate	TX.RX	L9. 10 L11. VR3	MAX Repeat the same procedure two or three times.	1.2 V	Adjust the setting range of RF voltmeter for peak value.
	2) MHz SW: 7 100 kHz SW: 9 10 kHz SW: 9	RF V.M	TX.RX	TP2	TX.RX	L12, 13	Repeat the same procedure two or three times.		
	3) MHz SW: 4 100 kHz SW: 0 10 kHz SW: 0	RF V.M.	TX.RX	RFI	TX.RX	L13	MAX		Use to RF prove 100 : 1
5. POWER	1) POWER SW: OFF Power module lead: Soldering a RFT terminal.								
	2) MHz SW: 6 100 kHz SW: 0 10 kHz SW: 0 POWER SW: ON	POWER METER			TX.RX	TC2	MAX		
	3) Same as above	POWER. M DC A.M	rear panel	ANT.	TX.RX	L19	Adjust for 12W (if the power is less than 12 W make adjustment according to the procedure in Item (4) below.	Less than 3.0A	
	4) Same as above	POWER.M DC A.M			TX.RX	TC2	Adjust L19 to increase to capacity.		
	5) MHz SW: 4	POWER.M DC A.M						More than 10 W	Confirm
	6) MHz SW: 7 100 kHz SW: 9 10 kHz SW: 9	POWER.M DC A.M						More than 10 W Less than 3 A	Confirm
6. RF METER	1) MHz SW: 6 100 kHz SW: 0 10 kHz SW: 0 TX.RX unit VR6: Center	RF METER	front panel		TX.RX	L21 L22	Adjust L22 so that meter indicates "8" on the scale		
	2) Same as above	RF METER			TX.RX	VR6	Meter indicates "8".		
7. LOW POWER	1) HI/LOW SW: LOW	POWER.M panel			TX.RX	VR9	1.2W	Check that the meter lamp changes from to green.	
	2) MHz SW: 4	POWER.M						0.8 W～1.5 W	
	3) MHz SW: 7 100 kHz SW: 9 10 kHz SW: 9	POWER.M	rear panel	ANT.				0.8W～1.5W Power check output	Confirm

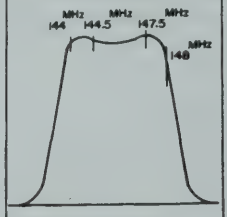
ADJUSTMENT

Item	Condition	Measuring point			Adjusting point			Reference	Remarks
		(Measure instruments)	Unit	Terminal	Unit	Parts	Method		
8. Output at the 11.5V (power supply)	1) DC Terminal: 11.5 V	POWER METER	rear panel	ANT.				Power check output	Confirm
	2) MHz SW: 6 10 kHz SW: 0 100 kHz SW: 0							Check power output	Confirm
	3) MHz SW: 4							Check power output	Confirm
	4) HI/LOW SW: HI							More than 6.0W	Confirm
	5) MHz SW: 6							More than 6.0W	Confirm
	6) MHz SW: 7 100 kHz SW: 9 10 kHz SW: 9							More than 6.0W	Confirm
9. Frequency SET	1) DC Terminal: 13.8V 2) MHz SW: 6 100 kHz SW: 0 10 kHz SW: 0	Frequency Counter	rear panel	ANT M coupling	TX.RX	TC1	146.000 MHz	±200 Hz	
10. Protection	1) Connect the Power Meter to the ANTENNA	DC V.M	TX.RX	TP4	TX.RX	VR5	MIN		
	2) Disconnect the Power to the ANTENNA TX.RX unit VR8: near centered	DC A.M	front panel		TX.RX	VR8	1.2A Check that the power is decrease when the power meter is disconnected.		
	3) MHz SW: 4	DC A.M						Approx. 1.2A	Confirm
	4) MHz SW: 7 100 kHz SW: 9 10 kHz SW: 9	DC A.M					Approx. 1.2A	Approx. 1.2A	Confirm
	5) Connect the power meter to the ANTENNA.	POWER.M	rear panel	ANT.				Power output go on again	Confirm
11. Deviation	1) MHz SW: 6 100 kHz SW: 0 10 kHz SW: 0 AG OUTPUT: 30 mV/ 1 kHz	Linear Detector			TX.RX	VR2	5.0 kHz		
	2) AG OUTPUT: 3 mV/ 1 kHz	Linear Detector			TX.RX	VR1	3.5 kHz		
12. SUBTONE	1) MIC Terminal: OPEN SEND/REC. SW: SEND AG OUTPUT: 300 mV/ 1 kHz SUBTONE SW: ON	Linear Detector		SUB G >AG TB...DC V.M				1) Check that output waveform from the Linear Detector 2) Confirm that TV Terminal Voltage is approx. 10V	Confirm
13. Abnormal Oscillation	1) Same as above	Linear Detector						Very the power voltage from 11.5 to 16 V for each item to check for abnormal oscillation	
	2) HI/LOW SW: LOW								
	3) MHz SW: 4								
	4) HI/LOW SW: HI								
	5) MHz SW: 7 100 kHz SW: 9 10 kHz SW: 9								
	6) HI/LOW SW: LOW								
14. Shift & Memory Shift	1) MHz SW: 5 100 kHz SW: 0 10 kHz SW: 0 5 kHz SW: 0 HI/LOW SW: HI DC terminal: 13.8V MODE SW: ⊖ SEND/REC. SW: SEND MR SW: OFF	F.Count	rear panel	ANT. M coupling				144.400 MHz	
	2) MODE SW: ⊕	F.Count	rear panel	ANT.				145.000 MHz	Confirm
	3) MHz SW: 7 MODE SW ⊖	F.Count	rear panel	ANT.				146.400 MHz	Confirm
	4) MODE SW: ⊕	F.Count	rear panel	ANT.				147.600 MHz	Confirm
	5) MODE SW: S M SW (NON-LOCK): ON								Confirm

ADJUSTMENT

Item	Condition	Measuring point			Adjusting point			Reference	Remarks
		(Measure instruments)	Unit	Terminal	Unit	Parts	Method		
	6) MHz SW: 4 MODE SW: M (green)	F.Count	rear panel	ANT.				147.000 MHz Check that indication "7.000".	Confirm
	7) MODE SW: S	F.Count	rear panel	ANT.				144.000 MHz	Confirm
	8) MR SW: ON	F.Count	rear panel	ANT.				147.000 MHz Check that indication "7.000".	Confirm
15. Paint lock	1) L10, L11, L12, L13								

3. Adjustment of Receiver section

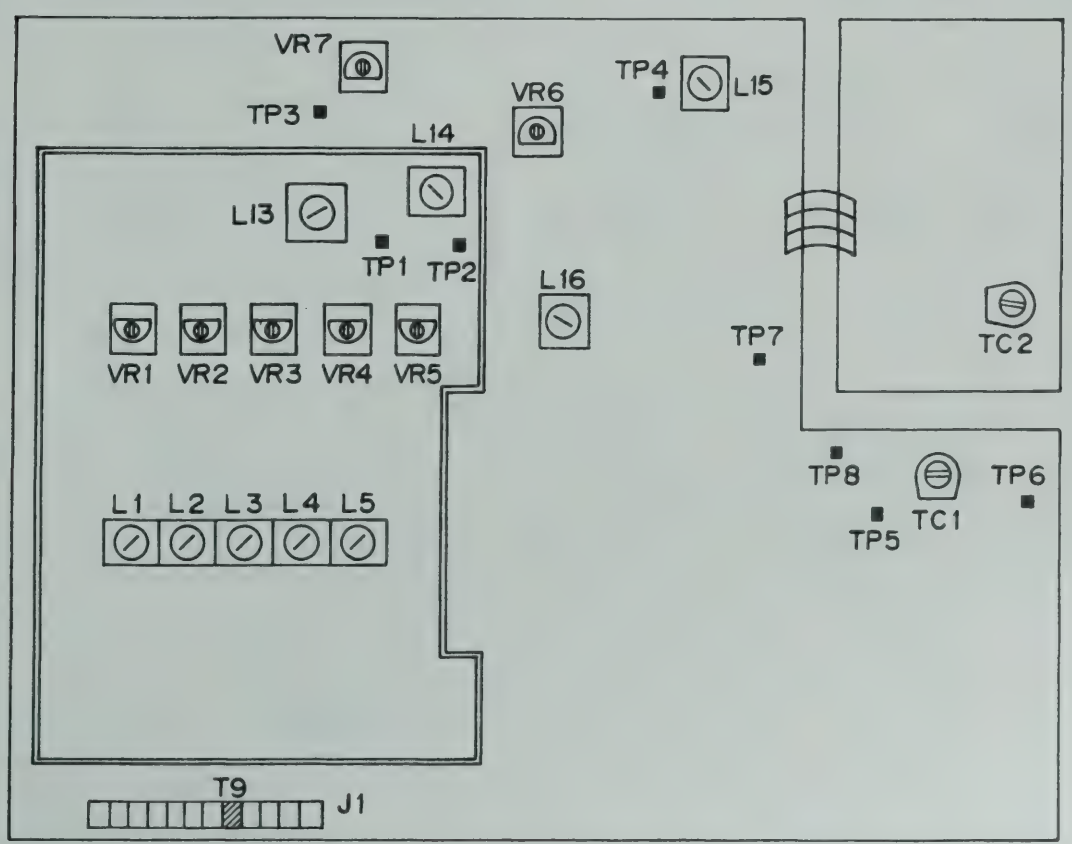
Item	Condition	Measuring point			Adjusting point			Reference	Remarks
		(Measure instruments)	Unit	Terminal	Unit	Parts	Method		
1. SETTING	1) POWER SW: ON HI/LOW SW: LOW MR SW: OFF MODE SW: S MHz SW: 5 100 kHz SW: 9 10 kHz SW: 5 5 kHz SW: 0 SUBTONE SW: OFF REMOTE SW: ON SEND/REC. SW: REC. SQUELCH VR: MIN EXT SP (terminal): AF V.M (8Ω) Oscilloscope								
2. Herical block	1) ANT terminal: SWEEP Oscilloscope VERT.GAIN: MAX	Oscillo- scope (Detector)	TX.RX	TP5	TX.RX	L29,30 L31 L32 (abc) (L33)	Adjust for a maximum gain and for a waveform as shown at right. Adjust L29 and L30 for a maximum waveform. Adjust L31, L32 (a.b.c) and L33 for a proper bandwidth and optimum waveform.	 Adjust L29 and L30 the waveform is distroted as shown below. 	Repeat
3. IF GAIN	1) REMOTE SW: OFF ANT UNIT: SSG (DEV.: 5 kHz. MOD.: 1 KHz SSG OUTPUT: Approx. 10 dB AF VR: 0.63 V/8Ω	AF V.M					Adjust SSG for correct frequency and set it to optimum waveform.		
	2) SSG OUTPUT: 5～10 dB	S METER			TX.RX	L34,35 L37	MAX. Repeat the same procedure two or three times.		
4. S METER	1) SSG OUTPUT: 30 dB	S METER			TX.RX	VR7	Set the scale 10 (30 V)	30 dB±4 dB	
5 Discriminator	1) SSG OUTPUT: 0 dB	AF V.M			TX.RX	L43	MAX		

ADJUSTMENT/PC BOARD ALIGNMENT

Item	Condition	Measuring point			Adjusting point			Reference	Remarks
		(Measure instruments)	Unit	Terminal	Unit	Parts	Method		
6. S/N (Signal to Noise ratio)	1) SSG OUTPUT: −6 dB 2) MHz SW: 4 100 kHz SW: 0 10 kHz SW: 0	AF V.M					With a signal received at each channel, set AF V.M to 0.63 V/8 . Next turn the SSG modulation OFF and measure the attenuation by AF V.M.	S/N 20 dB	Confirm
	3) MHz SW: 7 100 kHz SW: 9 10 kHz SW: 9	AF V.M					With a signal received, set AF V.M to 0.63V/8Ω. Next, turn the SSG modulation by AF V.M.	S/N 20 dB	Confirm
	4) MHz SW: 5 10 kHz SW: 9 SSG OUTPUT: 40 dB	AF V.M					With a signal received, set AF V.M to 0.63V/8Ω.	S/N 40 dB	Confirm
							Next, turn the SSG modulation OFF and measure the attenuation by AF V.M.		
7. SQUELCH	1) SSG OUTPUT: OFF SQV. VR: Critical point	Oscilloscope (or SP)						Critical point 9:00～11:00	Confirm
	2) SSG OUTPUT: −8 dB SQU. VR: Position of item (1)	Oscilloscope (or SP)						When a signal of −8 dB is applied from the SSG, the squelch should open	Confirm

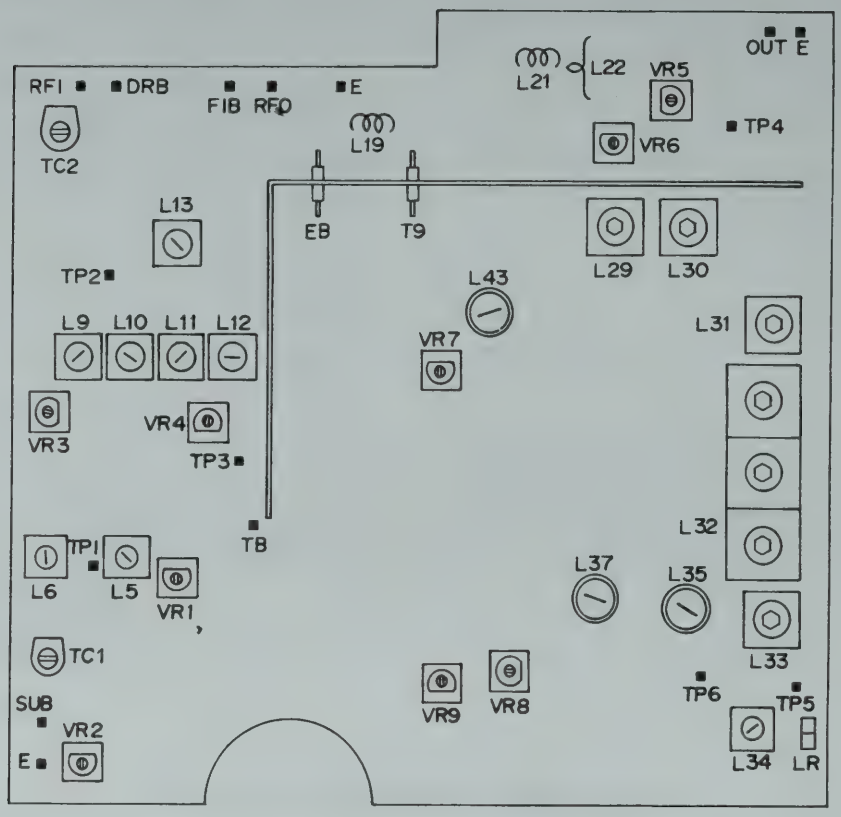
PC BOARD ALIGNMENT

PLL Unit (X50-1380-10)

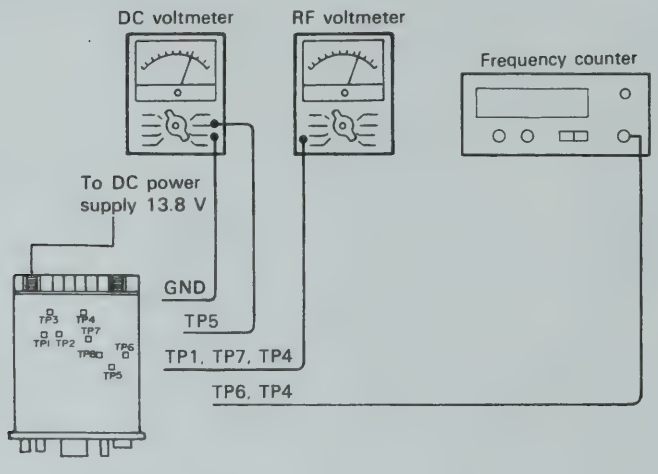


PC BOARD ALIGNMENT

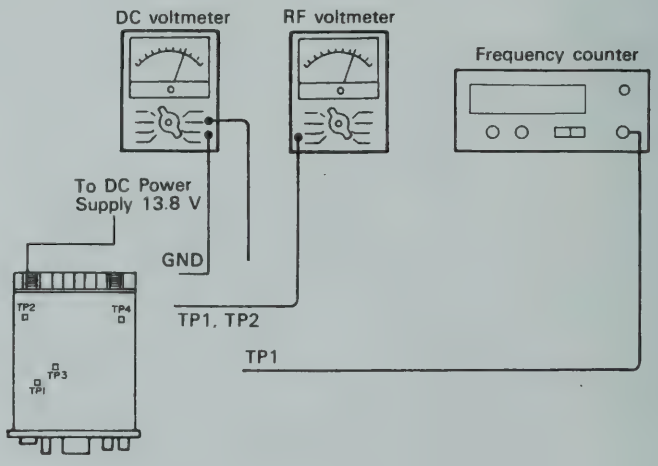
TX, RX Unit (X44-1300-10)



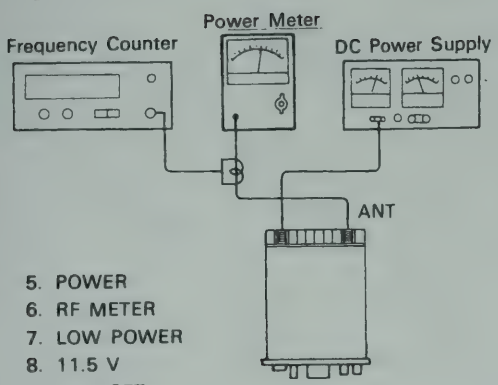
1. Adjustment of PLL Block



2. Tx Section adjustment

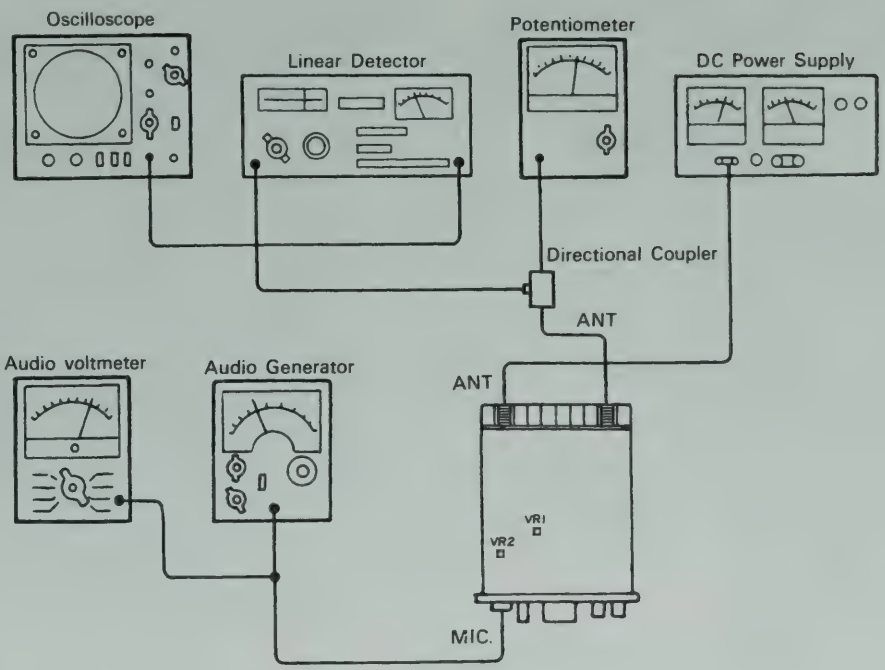


PC BOARD ALIGNMENT

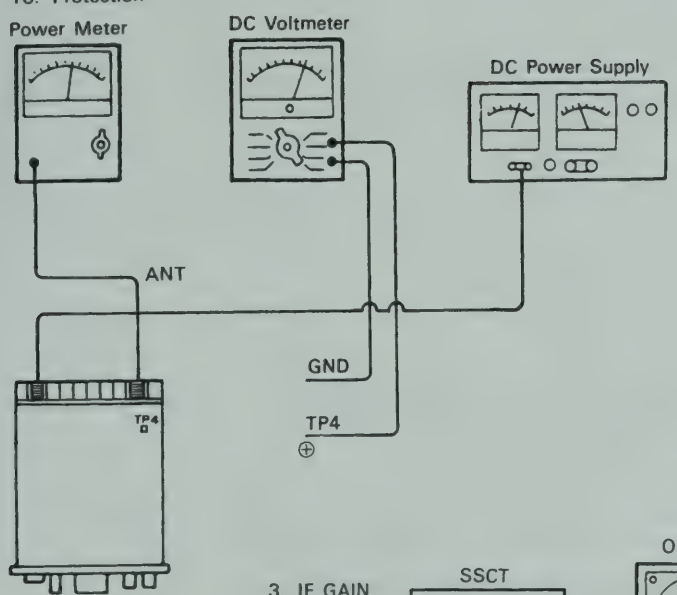


5. POWER
6. RF METER
7. LOW POWER
8. 11.5 V
9. Freq. SET
13. SHIFT AND MEMORY SHIFT

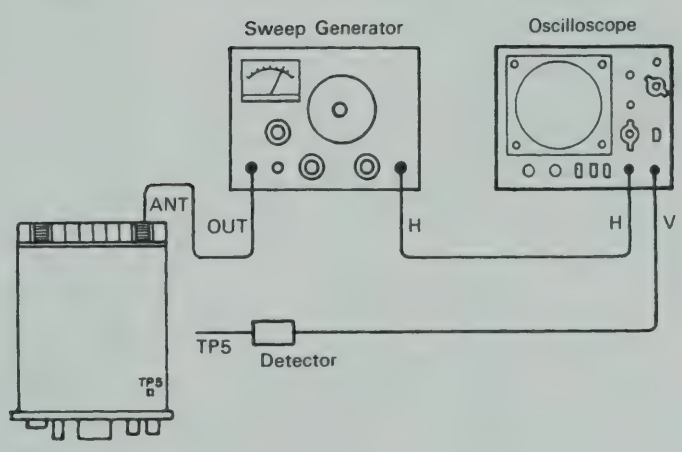
11. DEVIATION
12. ABNORMAL OSCILLATION



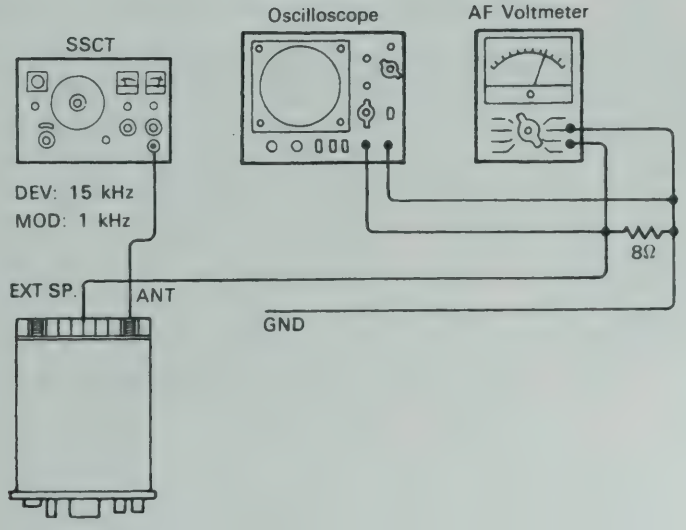
10. Protection



2. Helical



3. IF GAIN
4. S METER
5. Discretion
6. S/N
7. SQUELCH



SPECIFICATIONS

GENERAL

Semiconductors:	Transistors: 53 FETs: 9 ICs: 17 Diodes: 85
Frequency Range:	144.00 to 147.995 MHz
Frequency Synthesizer:	Digital control of phase locked VCO
Synthesizer Stability:	Less than ±750 Hz at 25°C
Mode:	FM
No. of Channels:	800
Operating Temperature:	−20 to +50°C
Power Voltage:	11.5V DC to 16.0V DC (13.8V DC standard)
Grounding:	Negative grounding
Antenna Impedance:	50Ω
DC Current:	Less than 0.5A in receive with no input signal Less than 3A in HI transmit (at 13.8V DC)
Dimensions:	161 mm (6-5/16″) wide 61 mm (2-3/8″) high 230 mm (9-1/16″) deep
Weight:	1.75 kg (3.85 lbs) Approx.

TRANSMITTER SECTION

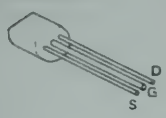
RF Output Power:	High: 10 watts (min.) Low: 1 watts approx. (adjustable to 10 watts)
Modulation:	Variable reactance direct shift
Max. Frequency Deviation:	±5 kHz
Spurious Radiation:	Less than −60 dB
Touch Tone Input Impedance:	600Ω
Microphone:	Dynamic microphone with PTT switch, 500Ω

RECEIVER SECTION

Circuitry:	Double superheterodyne
Intermediate Frequency:	1st: IF 10.7 MHz 2nd: IF 455 kHz
Sensitivity:	Less than 0.4 μV for 20 dB quieting (Less than 1 μV for 30 dB S/N)
Squelch Sensitivity:	Less than 0.25 μV
Pass Band Width:	More than 12 kHz at 6 dB down
Selectivity (2 Signal):	More than 76 dB at 30 kHz of adjacent channel
Image Rejection:	More than 70 dB
Spurious Interference:	More than 60 dB
Intermodulation:	More than 66 dB
Audio Output:	More than 1.5 watts across 8Ω load (10% distortion)

NOTE: The circuit and ratings may change without notice due to developments in technology.

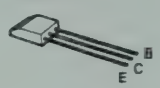
2SK30A(GR)



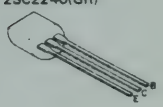
2SA496(Y)

2SK19(GR)

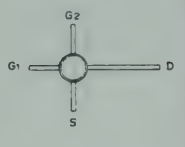
2SC460(B)



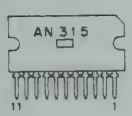
2SA1015(Y)
2SC1345(E)
2SC1815(Y)
2SC1923(O)
2SC1959(Y)
2SC2240(GR)



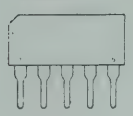
3SK74(L)



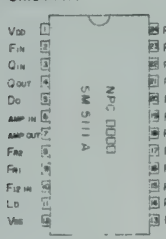
AN315



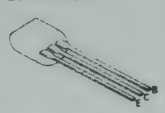
TA7060P



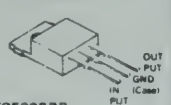
SM5111A



2SA1015(Y)
2SC1815(Y)



FS-7806M



TC5022BP
TC40198P
TC4035BP

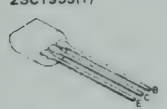
TC4081P

2SA496(Y)
2SC496(Y)

2SK19(GR)

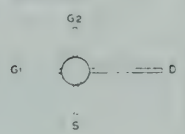
2SC460(B)

2SA1015(Y)
2SC1815(Y)
2SC1959(Y)



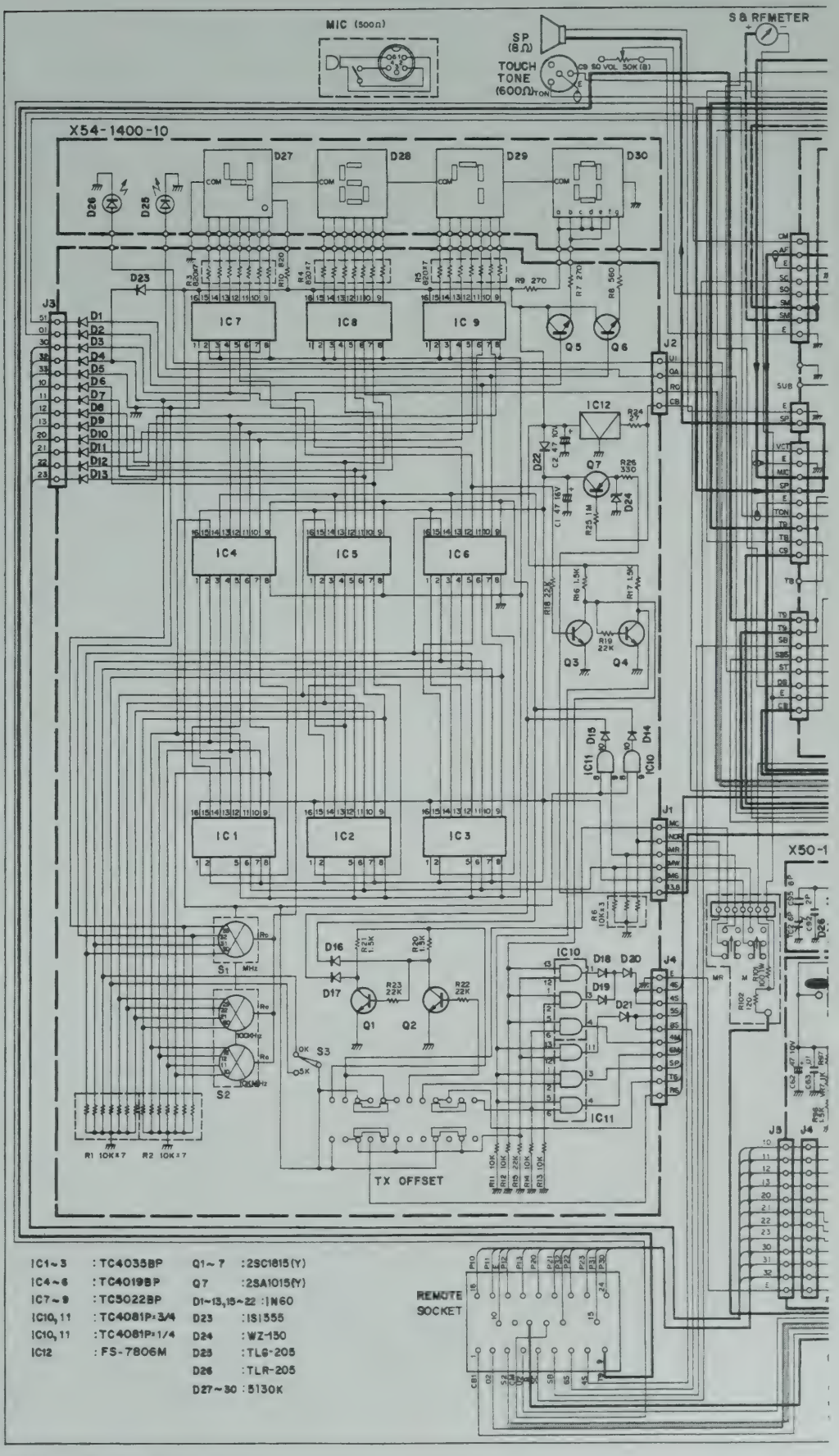
2SD235(Y)

3SK74(L)



2SC2053

M57711



IC1~3	: TC4035BP	Q1~7	: 2SC1815(Y)
IC4~6	: TC4019BP	Q7	: 2SA1015(Y)
IC7~9	: TC5022BP	D1~13,15~22	: 1N60
IC10, 11	: TC4081P×3/4	D23	: 1S1555
IC10, 11	: TC4081P×1/4	D24	: WZ-130
IC12	: FS-7806M	D25	: TLG-205
		D26	: TLR-205
		D27~30	: 5130K

① RFI, ② DRB, ③ FIB, ④ RFO.

SPECIFICATIONS

GENERAL

Semiconductors:	Transistors: 53 FETs: 9 ICs: 17 Diodes: 85
Frequency Range:	144.00 to 147.995 MHz
Frequency Synthesizer:	Digital control of phase locked VCO
Synthesizer Stability:	Less than ±750 Hz at 25°C
Mode:	FM
No. of Channels:	800
Operating Temperature:	−20 to +50°C
Power Voltage:	11.5V DC to 16.0V DC (13.8V DC standard)
Grounding:	Negative grounding
Antenna Impedance:	50Ω
DC Current:	Less than 0.5A in receive with no input signal Less than 3A in HI transmit (at 13.8V DC)
Dimensions:	161 mm (6-5/16″) wide 61 mm (2-3/8″) high 230 mm (9-1/16″) deep
Weight:	1.75 kg (3.85 lbs) Approx.

TRANSMITTER SECTION

RF Output Power:	High: 10 watts (min.) Low: 1 watts approx. (adjustable to 10 watts)
Modulation:	Variable reactance direct shift
Max. Frequency Deviation:	±5 kHz
Spurious Radiation:	Less than −60 dB
Touch Tone Input Impedance:	600Ω
Microphone:	Dynamic microphone with PTT switch, 500Ω

RECEIVER SECTION

Circuitry:	Double superheterodyne
Intermediate Frequency:	1st: IF 10.7 MHz 2nd: IF 455 kHz
Sensitivity:	Less than 0.4 μV for 20 dB quieting (Less than 1 μV for 30 dB S/N)
Squelch Sensitivity:	Less than 0.25 μV
Pass Band Width:	More than 12 kHz at 6 dB down
Selectivity (2 Signal):	More than 76 dB at 30 kHz of adjacent channel
Image Rejection:	More than 70 dB
Spurious Interference:	More than 60 dB
Intermodulation:	More than 66 dB
Audio Output:	More than 1.5 watts across 8Ω load (10% distortion)

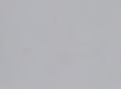
NOTE: The circuit and ratings may change without notice due to developments in technology.

SCHEMATIC DIAGRAM

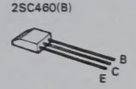
2SK30A(GR)

2SA496(Y)

2SK19(GR)

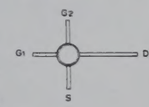


2SC460(B)

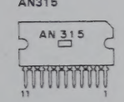


2SA1015(Y)
2SC1345(E)
2SC1815(Y)
2SC1923(O)
2SC1959(Y)
2SC2240(GR)

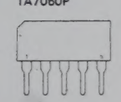
3SK74(L)



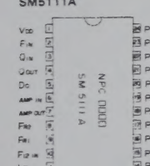
AN315



TA7060P

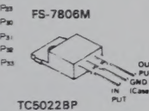


SM5111A



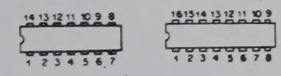
2SA1015(Y)
2SC1815(Y)

FS-7806M

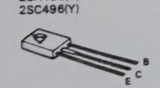


TC5022BP
TC4019BP
TC4035BP

TC4081P

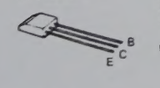


2SA496(Y)
2SC496(Y)



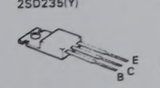
2SK19(GR)

2SC460(B)

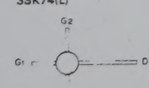


2SA1015(Y)
2SC1815(Y)
2SC1959(Y)

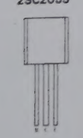
2SD235(Y)



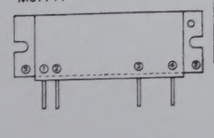
3SK74(L)

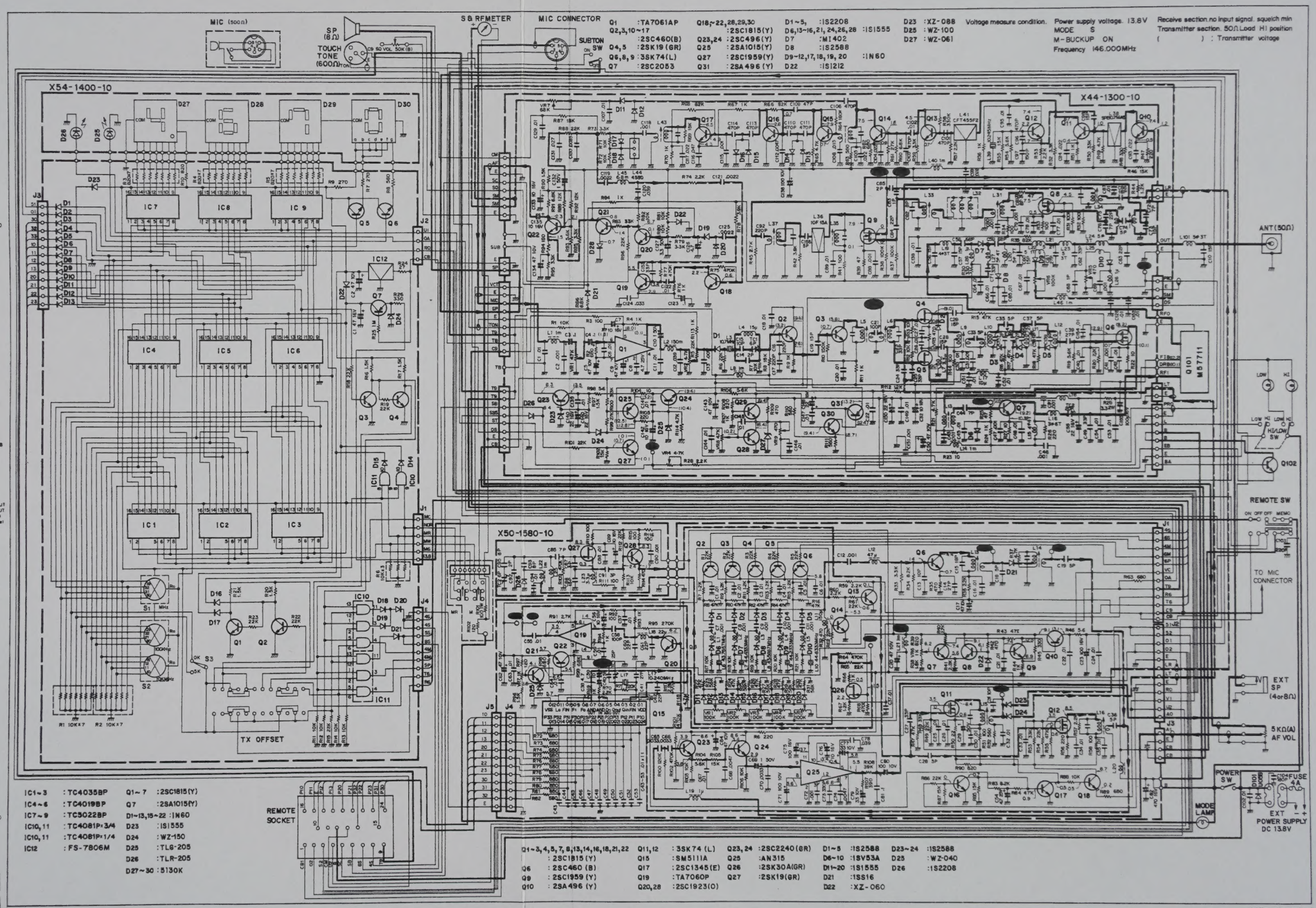


2SC2053



M57711





Q1 :TA7061AP
Q2,3,10~17 :2SC460(B)
Q4,5 :2SK19(GR)
Q6,8,9 :3SK74(L)
Q7 :2SC2053
Q18~22,28,29,30 :2SC1815(Y)
Q23,24 :2SC496(Y)
Q25 :2SA1015(Y)
Q27 :2SC1959(Y)
Q31 :2SA496(Y)
D1~5, D6,13~16,21,24,26,28 :IS2208
D7 :MI402
D8 :IS2588
D9~12,17,18,19,20 :IN60
D22 :IS1212
D23 :XZ-088
D25 :WZ-100
D27 :WZ-061

Voltage measure condition. Power supply voltage. 13.8V MODE S M-BUCKUP ON Frequency 146.000MHz

Receive section no input signal. squelch min
Transmitter section. 50Ω Load HI position
( ) : Transmitter voltage

IC1~3 :TC4035BP
IC4~6 :TC4019BP
IC7~9 :TC5022BP
IC10,11 :TC4081P×3/4
IC10,11 :TC4081P×1/4
IC12 :FS-7806M

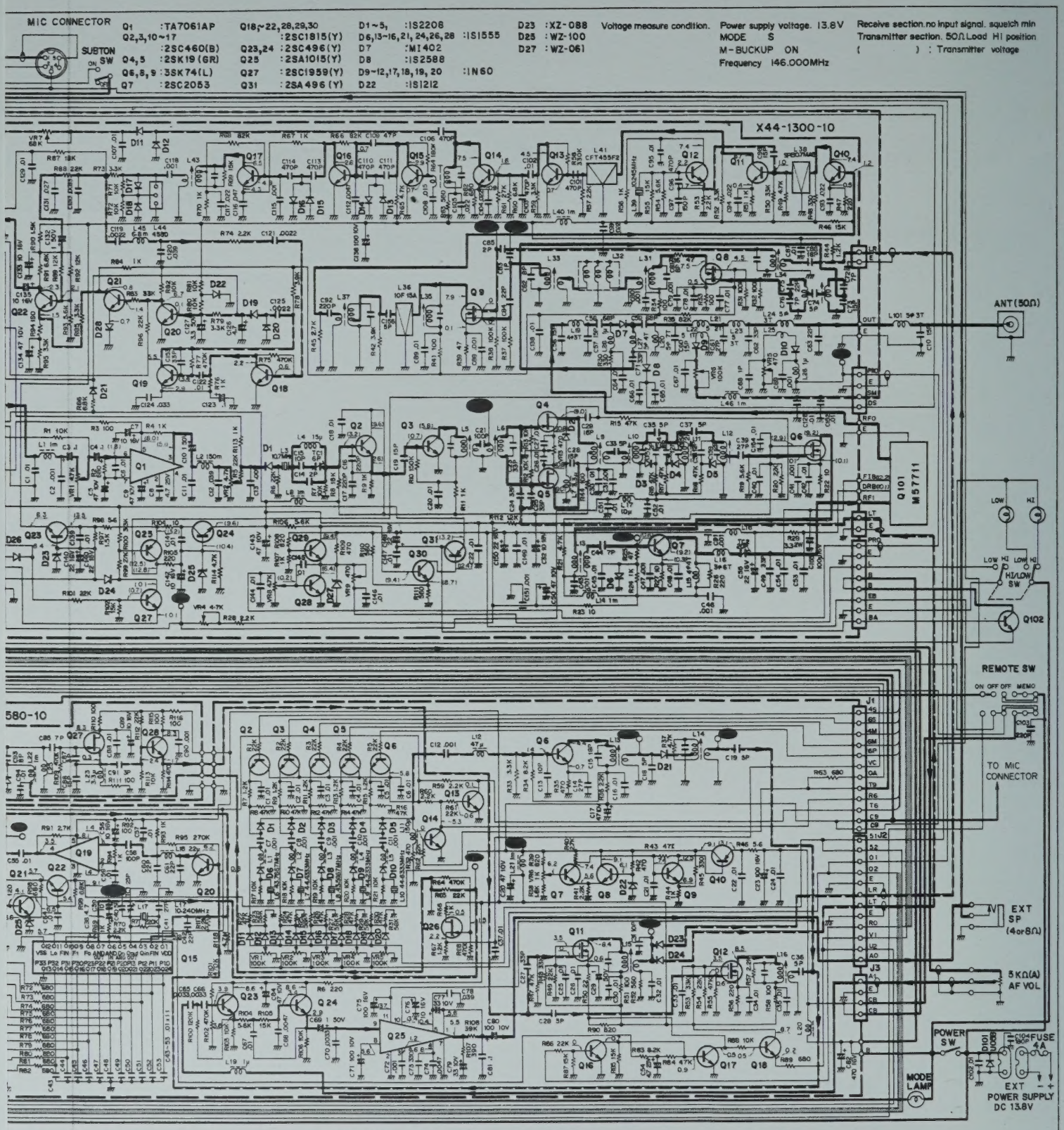
Q1~7 :2SC1815(Y)
Q7 :2SA1015(Y)
D1~13,15~22 :IN60
D23 :IS1555
D24 :WZ-150
D25 :TLG-205
D26 :TLR-205
D27~30 :5130K

Q1~3,4,5,7,8,13,14,16,18,21,22 :2SC1815(Y)
Q6 :2SC460(B)
Q9 :2SC1959(Y)
Q10 :2SA496(Y)
Q11,12 :3SK74(L)
Q15 :SM5111A
Q17 :2SC1345(E)
Q19 :TA7060P
Q20,28 :2SC1923(O)
Q23,24 :2SC2240(GR)
Q25 :AN315
Q26 :2SK30A(GR)
Q27 :2SK19(GR)
D1~5 :IS2588
D6~10 :1SV53A
D11~20 :IS1555
D21 :1SS16
D22 :XZ-060
D23~24 :IS2588
D25 :WZ-040
D26 :IS2208

① RFI, ② DRB, ③ FIB, ④ RFO.

TR-7600(K)

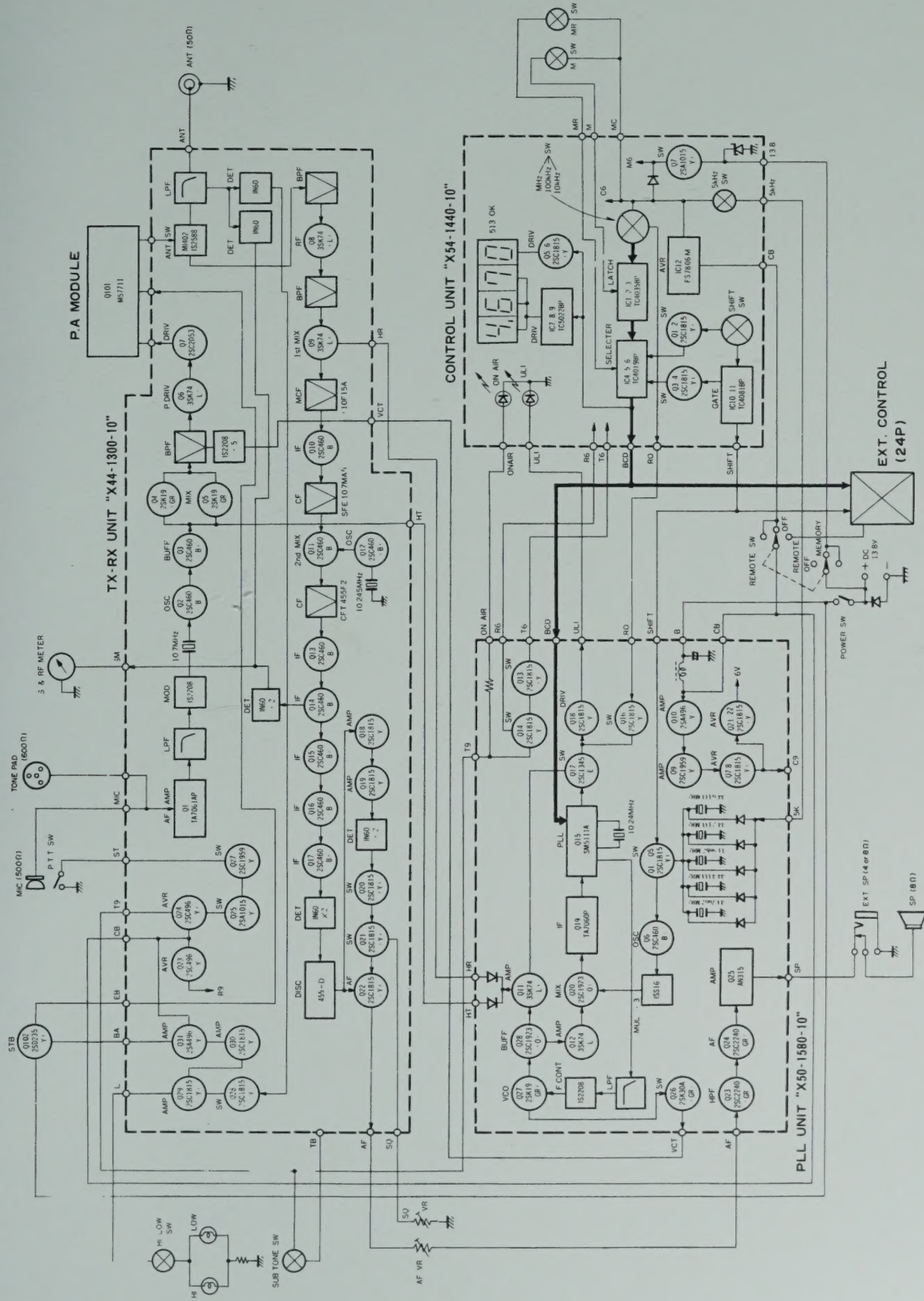
ATIC DIAGRAM



Q1~3,4,5,7,8,13,14,16,18,21,22 : 2SC1815(Y)
Q6 : 2SC460(B)
Q9 : 2SC1959(Y)
Q10 : 2SA496(Y)
Q11,12 : 3SK74(L)
Q15 : SM5111A
Q17 : 2SC1345(E)
Q19 : TA7060P
Q20,28 : 2SC1923(O)
Q23,24 : 2SC2240(GR)
Q25 : AN315
Q26 : 2SK30A(GR)
Q27 : 2SK19(GR)
D1~5 : 1S2588
D6~10 : 1SV53A
D11~20 : 1S1555
D21 : 1SS16
D22 : XZ-060
D23~24 : 1S2588
D25 : WZ-040
D26 : 1S2208

TR-7600(K)

BLOCK DIAGRAM



A product of
TRIO-KENWOOD CORPORATION
6-17, 3-chome, Aobadai, Meguro-ku, Tokyo 153, Japan

TRIO-KENWOOD COMMUNICATIONS, INC.
1111, West Walnut Street, Compton, California, 90220, U S A
TRIO-KENWOOD COMMUNICATIONS, GmbH
D 6374 Steinbach TS, Industriestrasse 8A, West Germany
TRIO-KENWOOD(AUSTRALIA)PTY. LTD.
30 Whiting Street, Artarmon, Sydney N S W Australia 2064

1978-12 PRINTED IN JAPAN B51-0865-00 1000 (K)(W)(T) (G)